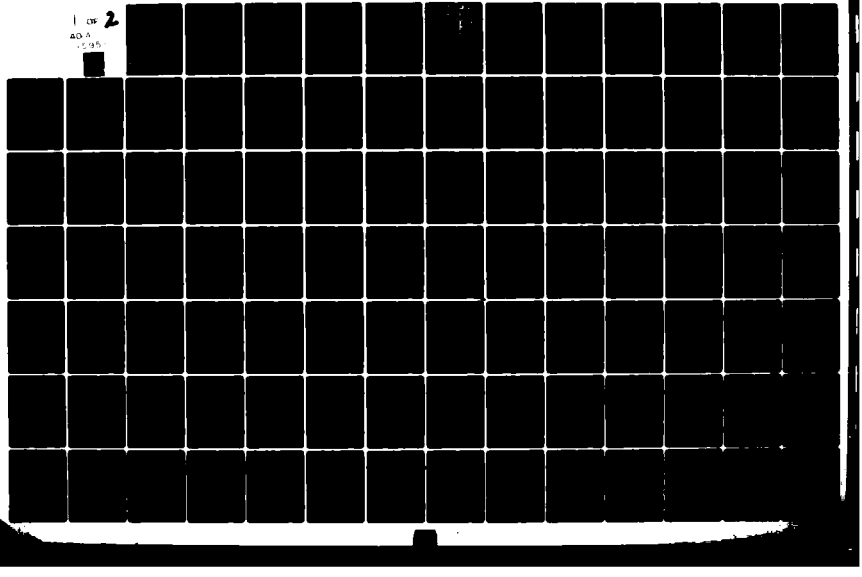
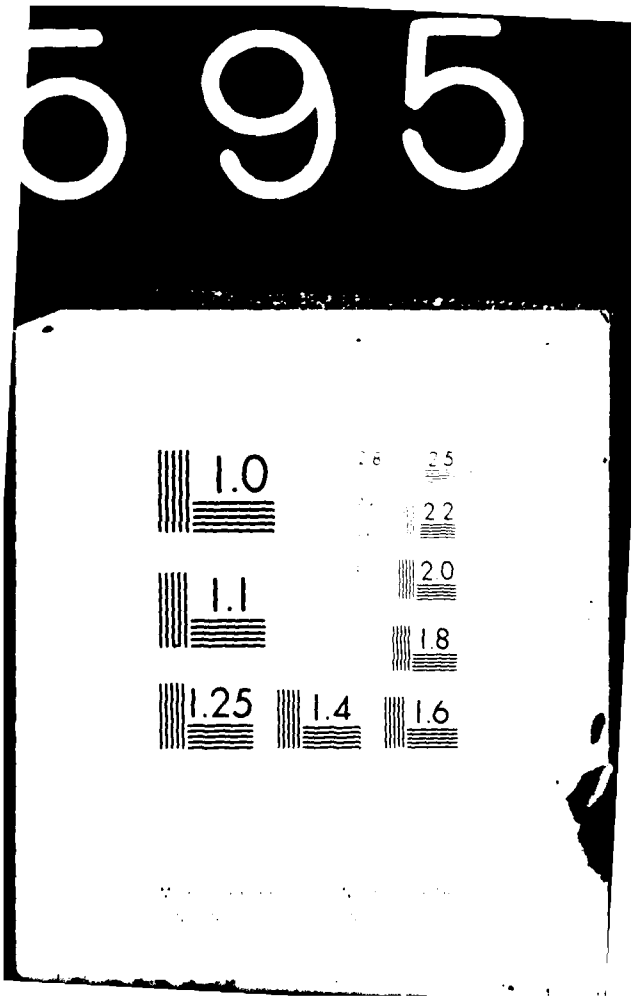
AD-A115 951 BULOVA SYSTEMS AND INSTRUMENTS CORP VALLEY STREAM N Y F/6 14/2
FEASIBILITY STUDY OF ADAPTATION OF AUTOMATIC NON-CONTACT INSPEC--ETC(U)
JUN 79 M BRAVERMAN DAAA25-76-C-0344

UNCLASSIFIED NL




595
1.0
1.1
1.25
1.4
1.6
2.0
1.8
2.2
2.5

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Project 929
5 June 1979

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FEASIBILITY STUDY
ADAPTATION OF
AUTOMATIC NON-CONTACT INSPECTION MACHINE
TO
INSPECTION OF M577 MTSQ FUZE LAMINAR COMPONENTS

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BULOVA SYSTEMS & INSTRUMENTS CORPORATION

82

BULOVA SYSTEMS & INSTRUMENTS CORPORATION
P.O. BOX 189, VALLEY STREAM, N Y 11582
TEL 516-561-2600 TWX 510-225-8409

13 April 1981
In Reply Refer: CA-AGS-8973

Department of the Army
U. S. Army Armament
Research and Development Command
Dover, New Jersey 07801

Attention: Mr. Charles Guerriere
Procuring Contracting Officer

Subject: Contract DAAA25-76-C-0344
Automated Inspection System

Gentlemen:

Pursuant to the subject contract, we are forwarding herewith two (2) copies of the following report required under Contract Item No. 0003 for your information and retention:

FEASIBILITY STUDY
ADAPTATION OF
AUTOMATIC NON-CONTACT INSPECTION MACHINE
TO
INSPECTION OF M577 MTSQ FUZE LAMINAR COMPONENTS

Very truly yours,

Bulova
Systems & Instruments Corporation

A. G. Schmitt
Contracts Administrator

AGS/ev
Enclosures

cc: ARRADCOM, Dover, N. J. 07801
Attention: Mr. T. McKimm
DRDAR-LCF-T Enc.

DCASMA, New York
Attention: Mr. St. Clair Reide, Sr., ACO
DCRN-GNCA-2

BULOVA SYSTEMS & INSTRUMENTS CORPORATION

FEASIBILITY STUDY
ADAPTATION OF
AUTOMATIC NON-CONTACT INSPECTION MACHINE
TO
INSPECTION OF M577 MTSQ FUZE LAMINAR COMPONENTS

CONTRACT DAAA25-76-0344 (EXTENDED SCOPE)
DATED 5 JUNE 1979

Submitted by:

M. Braverman
Senior Project Engineer

Approved by:

S. H. Sugarman, P. E.
Manager, Laboratory Services

DI-2267

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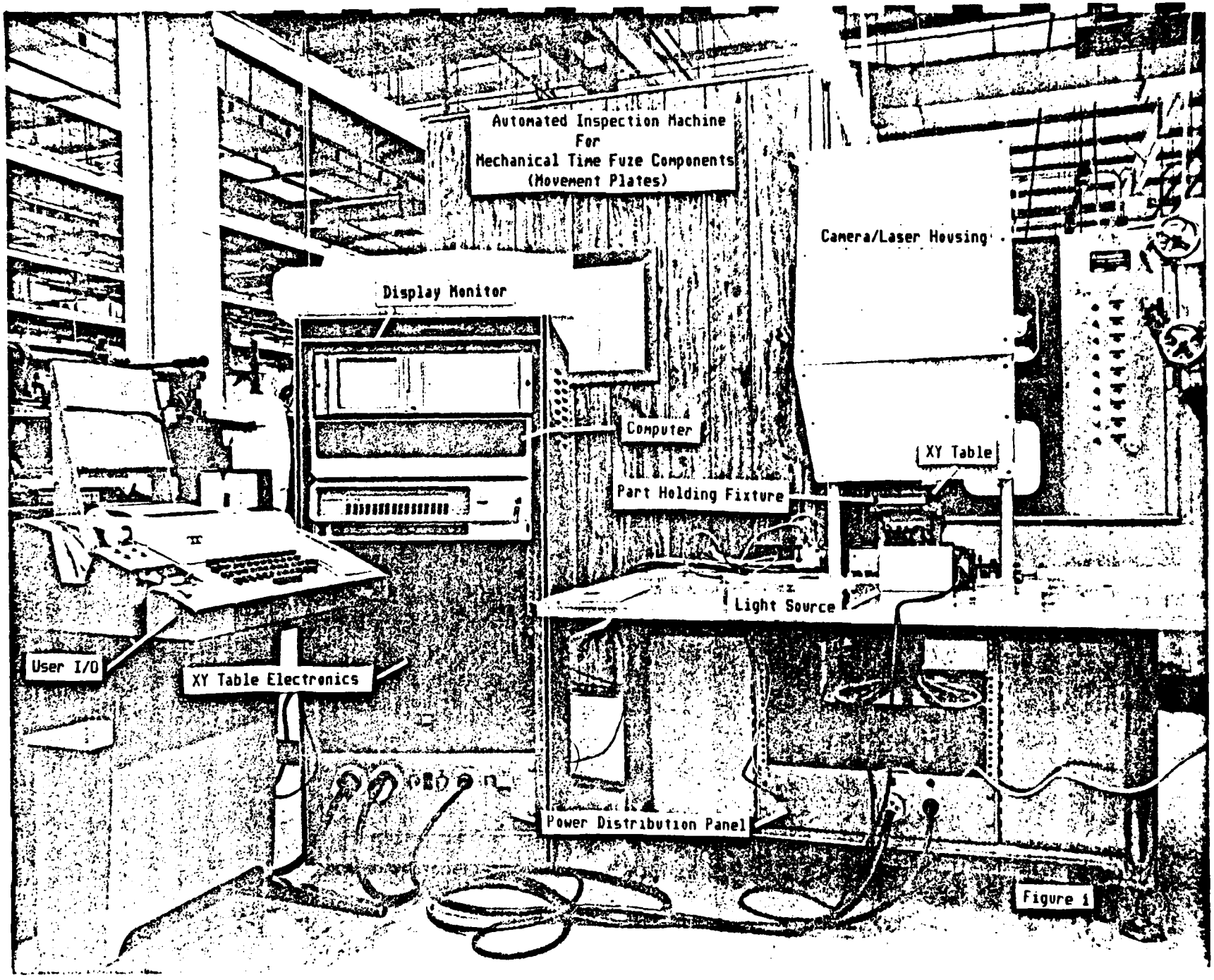

Automated Inspection Machine
For
Mechanical Time Fuze Components
(Movement Plates)
Camera/Laser Housing
Display Monitor
Computer
XY Table
Part Holding Fixture
Light Source
User I/O
XY Table Electronics
Power Distribution Panel

Figure 1

INTRODUCTION

On June 5, 1979, authorization was given to proceed and show the adaptability of the Automatic Non-Contact Inspection Machine to various timer, SSD and trigger plate components of the M577 MTSQ Fuze. This effort was considered as an extention to the scope of work, under development, on Contract DAA25-76-0344.

The Bulova Systems and Instruments Corporation has already developed, under the above contract number, a prototype machine for automatic non-contact dimensional inspection of mechanical time fuze movement plates. (See figure #1).

In accordance with contractual requirements, this machine was designed and built to primarily inspect plate 1, first lamina of the MT, M571 fuze. (Drawing number F10542821). The machine was also designed with the flexibility to adapt to the measurement of other lamina with a minimum of conversion time.

The equipment was built and demonstrated to be capable of performing in accordance with requirements for the part for which it was designed. All information in this report is in full agreement with the Final Report, " Automatic Inspection Machine for Mechanical Time Fuze Components (Movement Plates) ", dated July 28, 1980 compiled for the technical requirements of the original contract. This document is the results and conclusions of the study of M577 plate inspection adaptibility and is made to demonstrate the feasibility and compatibility of the equipment to inspect similar lamina components used in the M577 MTSQ Fuze.

REQUIREMENTS

The requirements for the feasibility study are outlined below

1. All component parts to be used for this study will be supplied by Bulova S&I Corp.

2. Bulova will fabricate all fixtures needed to hold components in the existing M571 fuze assembly.

3. Typical holes and features on the various plates to be studied will be selected by Bulova S&I Corp. to demonstrate the complete range of the machine's ability to inspect these plates.

4. The machine will be programmed to inspect the selected holes and features according to their dimensional requirements.

5. Fuze components listed in Table 1 will be studied. Note that PN9236636 Plate Number 1, Timer will be given the highest priority for study.

TABLE 1

FUZE COMPONENTS TO BE STUDIED

Nomenclature	Part Number
Plate, Bottom, SSD	9236527
Plate, Top, SSD	9236553
Plate, Top, Trigger	9236608
Plate, Bottom, Trigger	9236627
Plate, No. 1, Timer	9236636
Plate, No. 4, Timer	9236669
Plate, No. 6, Timer	9236681

DESCRIPTION

Upon authorization to proceed with the feasibility study, a complete set of fixtures for all the hardware listed in Table 1 was designed and fabricated. The design of each fixture accomodated two of each lamina, in order to view a differant side of each plate. The symmetry requirement was excluded to allow fixture design simplicity. It was decided not to rotate the fixture to read each side of the same plate, because this design and measurement effort would only contain information of secondary importance to the ultimate feasibility criteria. A universal adapter (Figure 2) was designed and constructed to allow all lamina fixtures to interface with the existing M571 fuze indexing translation assembly, despite variations in individual fixture physical configuration.

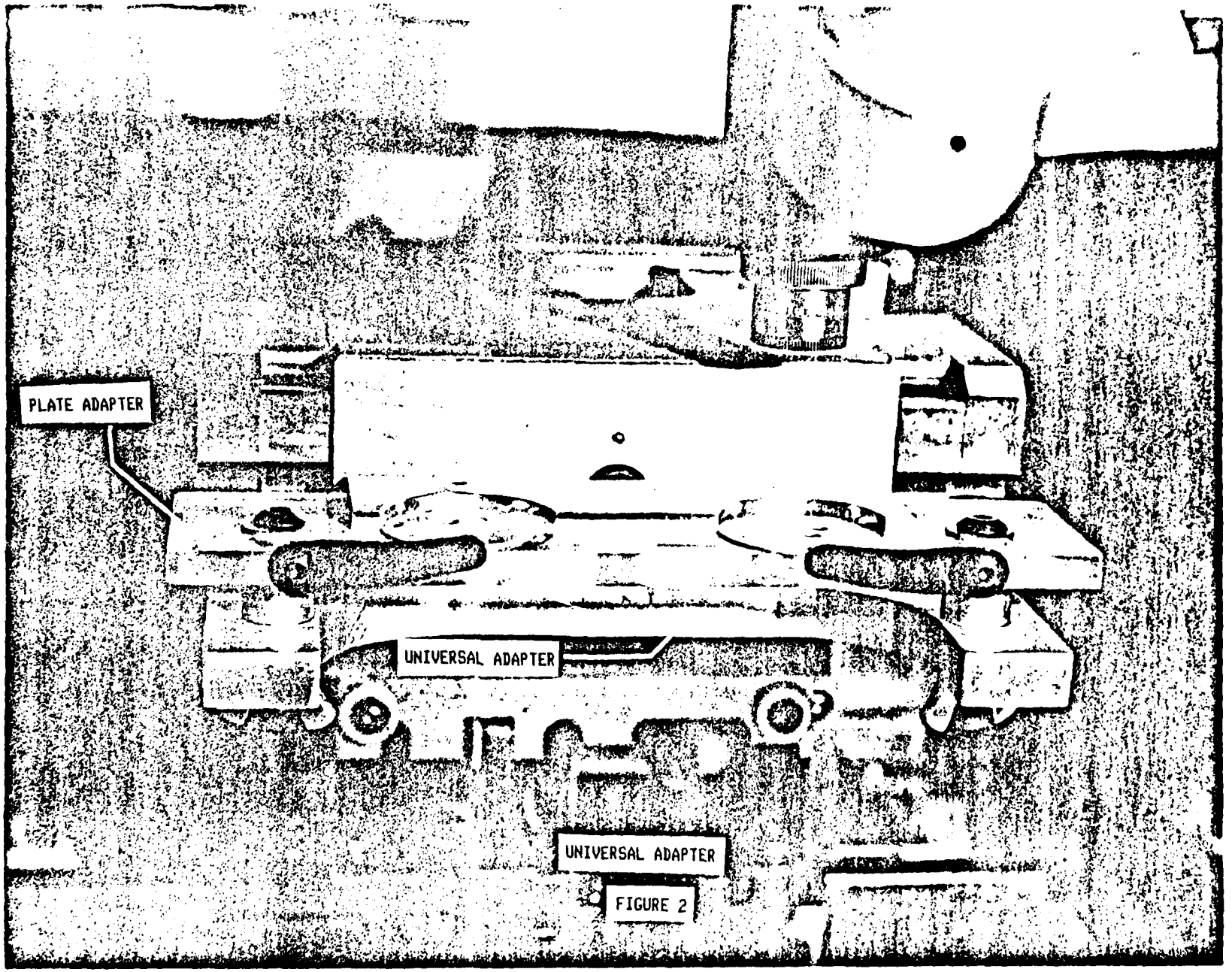


FIGURE 2

When the new M577 mounting hardware became available, the plates were mounted on their respective fixtures and checked for dimensional compatibility with the existing reference X and Y coordinates. Minor corrections were made in the plate holding clamps. Optical obstructions were either removed or noted for consideration when the actual inspection would be made.

Initially, analysis was started on timer plate #1, P/N 9236636, to verify that the features of this part were estimated to be beyond the immediate capabilities of the optics originally designed for the thinner M571 plates. The existing depth of field is in the order of .125 inches or 3.2 millimeters which is adequate for M571 components but insufficent for depth measurements on Plate #1 of the M577 fuze. No attempt was made to adapt the depth of field to the thicker plate. However conclusions were made concerning the adaption of the machine to accommodate the thicker M577 No. #1 plate and is presented further along in this report.

Another factor causing difficulties was that the depth measuring capability built into the machine for M571 plates was exceeded. The inspection machine depth measuring capability currently is a laser illuminator at a fixed angle of 45°. The laser beam is designed to hit the high edge of a depth feature, divide the beam into two spots and then be picked up by the optics within range of the depth under consideration. If a blind hole is deeper than its diameter, it is impossible to produce a double spot image at an angle of 45°. A different, steeper angle of approximately 68° should be chosen. The software algorithum must also be changed to calculate the depth with different laser beam angles. The existing program only accounts for the 45° angle but the resulting readout with the steeper angle could be corrected with an external proportional constant if the old algorithm is still used.

After considering the limitations for plate no. 1 measurements, the other plates were set up on the inspection machine with their appropriate fixtures. Input data for hole and feature parameters were programmed into the machine and inspection runs made. Compatibility of the program and hardware was found to be no differant from any M571 plate, with one small exception: The measurement depth of a tab that extended toward the lens instead of away from the lens system. The original system was programmed with the starting spot at the same level as the top of the lamina plate. The finish spot was to be at the depth level to be measured. On a projection extending toward the lens, the starting point is still taken at the top of the lamina. The finish spot, however, is presented 180° in the other direction on the "Y" axis. It is not clear whether or not there is any directional sign accommodation in the algorithm nor has it been established that the reversal in direction will cause unseen problems in the program. With the system in its present form, evaluation of depth with a projection toward the lens system can be accomplished by using comparison type measurements.

CONCLUSION

All project criteria outlined in the Final Technical Report for the Automated Inspection Machine for Mechanical Time Fuze Components (Movement Plates) are applicable to the M577 production program, with the exception of Plate No. 1 Timer, PN 9236636.

This information was obtained from a detailed evaluation of plate no. 4. Due to the limited nature and funding of the feasibility study, more detailed testing and feature programming was done on one typical plate rather than marginal testing of all plates. Two acceptable number 4 plates after passing Bulova inspection, were taken and evaluated by the automatic inspection machine. These plates had all the features necessary to evaluate the performance of the machine. This also included evaluation of a projection on one hole slot to satisfy the laser depth measurement requirements. Computer print outs for ten inspection runs are contained in Appendix 2. ' The plate number 4 hole location assignment drawings are in Appendix #1. True Position Tolerance details are in Appendix V and Hole and Feature Measuremements Techniques are in Appendix V1.

RECOMMENDATIONS

It must be emphasized that this machine was contracted as, and always has been considered, a prototype design whose ultimate use would be high volume precision measurement of fuze movement plates. It was envisioned that this design would serve as a basis for a group of production inspection machines strategically placed in high volume manufacturing facility. While this individual machine was designed to satisfy this prototype requirement in concept, it was contracted to be a final piece of hardware for this purpose. The intent was to prove that the original study could be turned into hardware. This unit is therefore not recommended as a working production machine unless additional funding and effort is expended to systematically intergrate all phases of the developement into a system capable of surviving a typical industrial enviroment.

To insure compatibility with Plate No. 1 the following modifications should be made:

1. Either increase the depth of field to .425 inches (10.8 millimeters) or add a variable servo controlled "Z" (third) axis. This axis would vary the distance of the computer and the lens from the inspection point. The distance would be computer controlled.

2. A turret with several available remotely selectible magnifications using multiple lens combinations should be incorporated, with the lens selected operated under computer control.

3. An additional steeper angle laser depth illuminator should be added to the system for deep hole measurements.

4. A deep hole algorithm should be written to account for differant laser beam angles and spot starting points. As the present computer techniques develope, it becomes increasingly feasible to use soft ware package improvements to take advantage of features offered by the inspection machine in its extensive

sub-rountines. Currently, programming is handled on an assembly language basis. It is estimated that programming may only be handled by the one or two people who have the knowledge required to make economical and effective changes in the software.

5. It is recommended as was previously outlined in the past progress reports, that a dual language computer technique would offer a massive advantage to functional use of this machine. It is proposed again that all hardware oriented programs should be done in machine language, and all data handling, computation, and print out formating should be accomplished in a high level Basic, Fortran or Pascal language. Equipment software could be proprietary and tailored to meet the equipment requirements of high speed relability and safety. Data handling and perhaps limited control programming, done in high level language, would allow ordinary technical personnel to modify the program to meet the specific needs of the operational requirements of equipment and acceptance tests.

While the input-output capability is in the laymans language in the present inspection machine, there is very little thought given to satisfying some new requirement with user programming. Changes in format are a major effort and trouble shooting must be done on machine language level beyond the capability of the average project engineer. It is recommended that this type of program or complete change be instituted before any attempt to use, adapt or rebuild the inspection operation on the M577 program. Also, in no way should the high level language be part of an entire machine language software package. A separate universal language should stand on it's own, and through standard techniques should address seperate, dedicated hardware and machine language subroutines.

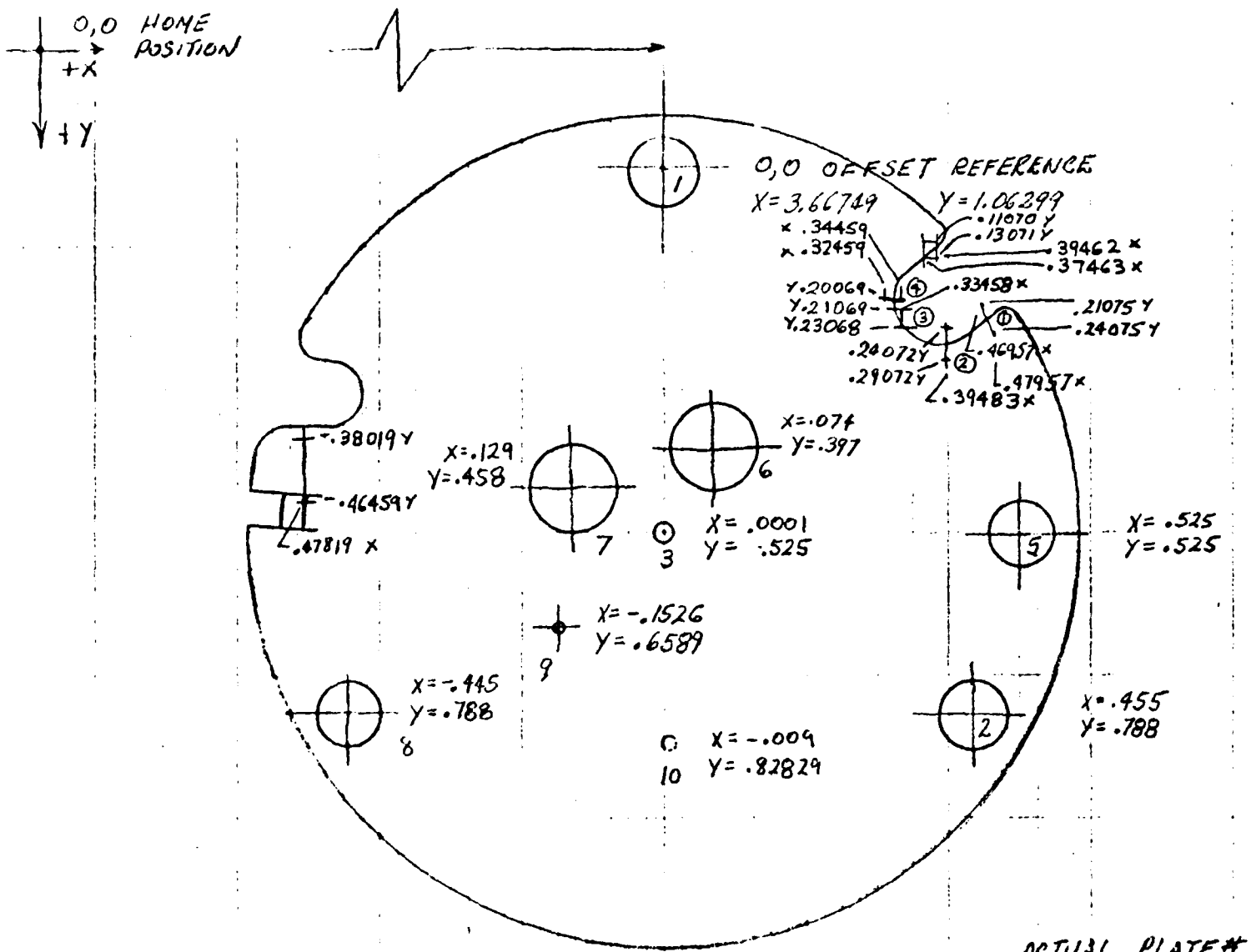
Written print outs for some typical inspections are given in Appendix A.
A Comparater Gage Operation Guide is also included for referance.

APPENDIX 1

HOLE AND FEATURE LOCATIONS PLATE NO. 4 TIMER

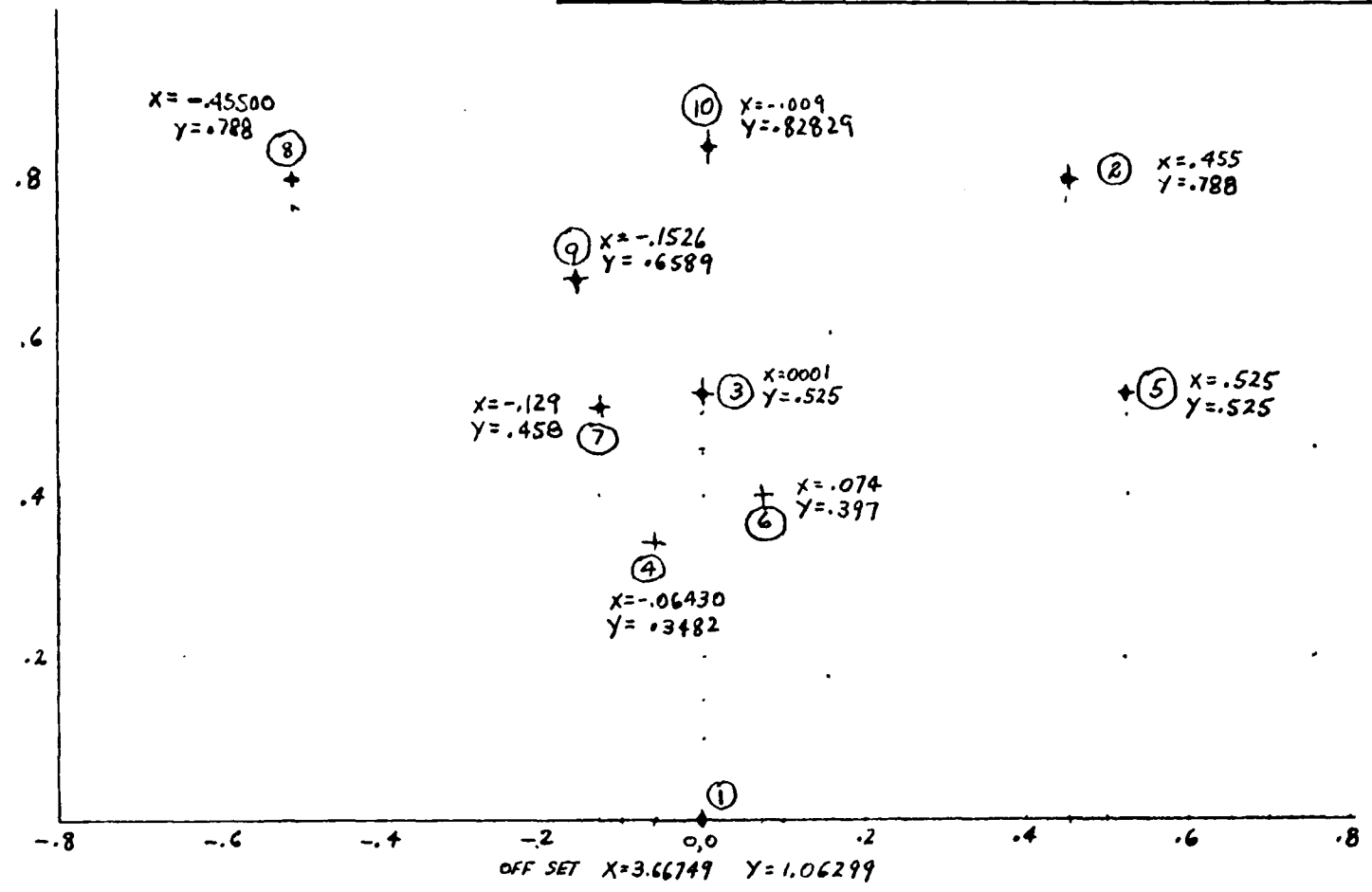
BY _____ DATE _____ SUBJECT _____ SHEET NO. _____ OF _____

CHKD. BY _____ DATE _____ JOB NO. _____



ACTUAL PLATE # 4
POSITION
HOLE AND FEATURE LOCATIONS
FIGURE 3

REVISIONS					
ZONE	LTR	BY	DESCRIPTION	DATE	APPROVED



		TOLERANCES UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	BULOVA / SYSTEMS AND INSTRUMENTS CORPORATION VALLEY STREAM, N. Y. 11582			
		FINISH ✓					
		ANGULAR ±	DESIGNED	HOLE LOCATIONS			
		FRACTIONAL ±	PREPARED	PLATE NO. 4 TIMER			
		CONCENTRICITY T.I.R.	CHECKED	DRAWING 9236669 (TYPICAL)			
		CORNERS MAX.	APPROVED				
		FILLETS MAX.	MATERIAL	SIZE A	CODE IDENT. NO. 28726		REV.
		.XX ±					
		.XXX ±					
		.XXXX ±	ORIGINAL ISSUE DATE / /				
		.XXXXX ±		SCALE	WEIGHT	SHEET OF	
NEXT ASSY	USED ON						
APPLICATION							

KEUFFEL & ESSER CO. 10 5186 7-70 41993

PROGRAM INPUT DATA

```
* HLOC1
HOLE CENTER SIDE 1 #1
XC:  +3.67749,
YC:  +1.06299,

HOLE CENTER SIDE 1 #2
XC:   +.45500,
YC:   +.78500,

HOLE CENTER SIDE 1 #3
XC:   +.00010,
YC:   +.52503,

HOLE CENTER SIDE 1 #4
YC:   -.06430,
YC:   +.34830,

HOLE CENTER SIDE 1 #5
YC:   +.52500,
YC:   +.52500,

HOLE CENTER SIDE 1 #6
XC:   +.07480,
YC:   +.39700,

HOLE CENTER SIDE 1 #7
XC:   -.12900,
YC:   +.45900,

HOLE CENTER SIDE 1 #8
YC:   -.45500,
YC:   +.78800,
```

HOLE CENTER SIDE 1 #9

XC: -.15060,

YC: +.65690,

HOLE CENTER SIDE 1 #10

XC: +.00900,

YC: +.00809,

HOLE CENTER SIDE 1 #11

XC: +.00302,

YC: +.00000,

HOLE CENTER SIDE 1 *

* HLOC2

HOLE CENTER SIDE 2 #1

XC: -2.37500,

YC: +.00100,

HOLE CENTER SIDE 2 #2

XC: -.45500,

YC: +.78800,

HOLE CENTER SIDE 2 #3

XC: +.00010,

YC: +.52500,

HOLE CENTER SIDE 2 #4

YC: +.06430,

YC: +.34830,

HOLE CENTER SIDE 2 #5

XC: -.52500,

YC: +.52500,

HOLE CENTER SIDE 2 #6

XC: -.07400,

YC: +.39700,

HOLE CENTER SIDE 2 #7

XC: +.12900,

YC: +.45800,

HOLE CENTER SIDE 2 #8

XC: +.45500,

YC: +.78800,

HOLE CENTER SIDE 2 #9

XC: +.15260,

YC: +.65890,

HOLE CENTER SIDE 2 #10

XC: -.00900,

YC: +.82829,

HOLE CENTER SIDE 2 #

* TDIA1

HOLE SIDE #1 TOL. #1

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #1 TOL. #2

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #1 TOL. #3

LOW: +.03100,

HIGH: +.03149,

HOLE SIDE #1 TOL. #4

LOW: +.01520,

HIGH: +.01580,

HOLE SIDE #1 TOL. #5

LOW: +.09450,

HIGH: +.09510,

HOLE SIDE #1 TOL. #6

LOW: +.13003,

HIGH: +.13500,

HOLE SIDE #1 TOL. #7

LOW: +.12500,

HIGH: +.13500,

HOLE SIDE #1 TOL. #8

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #1 TOL. #9

LOW: +.01629,

HIGH: +.01690,

HOLE SIDE #1 TOL. #10

LOW: +.02550,

HIGH: +.02610,

HOLE SIDE #1 TOL. #

* TDIA2

HOLE SIDE #2 TOL. #1

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #2 TOL. #2

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #2 TOL. #3

LOW: +.03100,

HIGH: +.03149,

HOLE SIDE #2 TOL. #4

LOW: +.01520,

HIGH: +.01580,

HOLE SIDE #2 TOL. #5

LOW: +.09450,

HIGH: +.09510,

HOLE SIDE #2 TOL. #6

LOW: +.12500,

HIGH: +.13500,

HOLE SIDE #2 TOL. #7

LOW: +.12500,

HIGH: +.13500,

HOLE SIDE #2 TOL. #8

LOW: +.10000,

HIGH: +.11000,

HOLE SIDE #2 TOL. #9

LOW: +.01629,

HIGH: +.01690,

HOLE SIDE #2 TOL. #10

LOW: +.02550,

HIGH: +.02610,

HOLE SIDE #2 TOL. #

* T4DIA1

HOLE 4-DIA TOL# 1

LOW: +.10000,

HIGH: +.11000,

HOLE 4-DIA TOL# 2

LOW: +.10000,

HIGH: +.11000,

HOLE 4-DIA TOL# 3

LOW: +.03100,

HIGH: +.03149,

HOLE 4-DIA TOL# 4

LOW: +.01520,

HIGH: +.01560,

HOLE 4-DIA TOL# 5

* T4DIA2

HOLE 4-DIA TOL# 1

LOW: -.00460,

HIGH: -.00460,

HOLE 4-DIA TOL# 2

LOW: +.00000,

HIGH: +.00000,

HOLE 4-DIA TOL# 3

LOW: +.00000,

HIGH: +.00000,

HOLE 4-DIA TOL# 4

LOW: +.00000,

HIGH: +.00000,

HOLE 4-DIA TOL#

* FLOC1

SIDE #1 FEATURE #1

SAX: +.46500,

SAY: +.21000,

EAX: +.47500,

EAY: +.24000,

SIDE #1 FEATURE #2

SAX: +.41000,

SAY: +.24000,

EAX: +.41000,

EAY: +.29000,

SIDE #1 FEATURE #3

SAX: +.35000,

SAY: +.21000,

EAX: +.33000,

EAY: +.23000,

SIDE #1 FEATURE #4

SAX: +.34000,

SAY: +.23000,

EAX: +.32000,

EAY: +.20000,

SIDE #1 FEATURE #5

SAX: +.39000,

SAY: +.13000,

EAX: +.37000,

EAY: +.11000,

SIDE #1 FEATURE #6

SAX: -.48270,

SAY: +.37990,

EAX: -.48270,

EAY: +.46430,

```
SIDE #1 FEATURE #7
SAX:    -.48270,
SAY:    +.46430,
EAX:    -.48270,
EAY:    +.37990,

SIDE #1 FEATURE #8
SAX:    +.00000,
SAY:    +.00000,
EAX:    +.00000,
EAY:    +.00000,

SIDE #1 FEATURE #9
SAX:    +.00000,
SAY:    +.00000,
EAX:    +.00000,
EAY:    +.00000,

SIDE #1 FEATURE #10
SAX:    +.00000,
SAY:    +.00000,
EAX:    +.00000,
EAY:    +.00000,

SIDE #1 FEATURE #
* FLOC2
SIDE #2 FEATURE #
```

```
* FLOC2
SIDE #2 FEATURE #1
SAX:  +1.00000,
SAY:   -.02599,
EAX:   -.17000,
EAY:   -.17000,

SIDE #2 FEATURE #2
SAX:   -.00250,
SAY:   -.00599,
EAX:   -.01000,
EAY:   -.07000,

SIDE #2 FEATURE #3
SAY:   +.00000,
SAY:   +.00000,
EAX:   +.00000,
EAY:   +.00000,

SIDE #2 FEATURE #
* HIGH1
* HIGH31
* HIGH#1
HEIGHT #1 COUNT BEGINS AT FEATURE #
* HTAG1
TAG ID #1
NOW: PSI=A   NEW:
TAG ID #
*
```

APPENDIX II

INSPECTION PRINT-OUTS

HOLE DATA PRINT OUTS

PS1, A — Disregard characters after comma (from original M571 program)

PM5, 11 — Second character see true position appendix V

S-Regardless of feature size
M-Maximum metal condition

Third character - hole or feature indentification (designation)

FEATURE MEASUREMENT PRINT OUTS

Leng# - feature designation

Init. - x, y coordinates which measuring machine scans to determine actual feature location

Loc'n - Actual feature location

Lower, Upper — Tolerance Limits

RUN -

B1

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01018	+.10000	
PS4,20	-.06430	+.34830	+.00775	+.10000	
PM5,11	+.52500	+.52500	+.01242	+.10131	
PS6,22	+.07400	+.39700	+.00401	+.10000	
PM7,12	-.12900	+.45800	+.00395	+.10799	
PM8,8	-.45500	+.78800	+.00691	+.11031	
PS9,48	-.15260	+.65890	+.00857	+.10000	
PS1045	+.00900	+.82829	+.00994	+.10000	

HOLE POSITION

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10968	+.10000	+.11000	
PS2,B	+.11053	+.10000	+.11000	FAIL
PS3,D	+.03286	+.03100	+.03149	FAIL
PS4,20	+.01487	+.01520	+.01580	FAIL
PM5,11	+.09581	+.09450	+.09510	FAIL
PS6,22	+.13328	+.10000	+.13500	
PM7,12	+.13299	+.12500	+.13500	
PM8,8	+.11031	+.10000	+.11000	FAIL
PS9,48	+.01565	+.01629	+.01690	FAIL
PS1045	+.02601	+.02550	+.02610	

HOLE DIAMETER

DISCEGARD

3002 - 000A DIST = +.18936

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46958	+.47340	+.44500	+.46500	FAIL
	+.21075	+.22234	+.22000	+.24000	
	+.47957			FERTILE	
	+.24075			DATA	
2-	+.41457	+.41457	+.40000	+.42000	
	+.24072	+.25958	+.27500	+.29500	FAIL
	+.41455				
	+.29072				
3-	+.35458	+.34393	+.33000	+.35000	
	+.21069	+.22120	+.21000	+.23000	
	+.33457				
	+.23068				
4-	+.34459	+.33768	+.32000	+.34000	
	+.20069	+.20069	+.19000	+.21000	
	+.32459				
	+.20068				
5-	+.39462	+.38584	+.37000	+.39000	
	+.13071	+.12185	+.11000	+.13000	
	+.37463				
	+.11070				

6-	-.47819	-.47819	-.57500	-.55500	FAIL
START X →	+.38019	+.38840	+.37500	+.42000	
START Y →					
END X →	-.47823				
END Y →	+.46459				
7-	-.47823	-.62569	-.75000	-.57500	
	+.46459	+.33556	+.30000	+.44800	
	-.47819				
	+.38019				

DEFT - FEATURE USES TWO FEATURE POSITIONS

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00244	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00264	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00317	+.01050	
PS6,22	-.07400	+.39700	+.00132	+.00399	
PM7,12	+.12900	+.45800	+.00168	+.01374	
PM8,8	+.45500	+.78800	+.00232	+.01617	
PS9,48	+.15260	+.65890	+.00567	+.00399	FAIL
PS1045	-.00900	+.82829	+.00463	+.00399	FAIL

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10980	+.10000	+.11000	
PS2,B2	+.10997	+.10000	+.11000	
PS3,D2	+.03330	+.03100	+.03149	FAIL
PS4,20	+.01630	+.01520	+.01580	FAIL
PM5,11	+.09650	+.09450	+.09510	FAIL
PS6,22	+.13351	+.12500	+.13500	
PM7,12	+.13314	+.12500	+.13500	
PM8,8	+.10967	+.10000	+.11000	
PS9,48	+.01529	+.01629	+.01690	FAIL
PS1045	+.02520	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18829

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85556	-.01000	-.00300	FAIL
	-.00599	-.13545	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00516	-.01000	-.00499	
	-.00599	-.05488	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

RUN

* DATA

C1

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00002	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01059	+.10000	
PS4,20	-.06430	+.34830	+.00768	+.10000	
PM5,11	+.52500	+.52500	+.01290	+.10126	
PS6,22	+.07400	+.39700	+.00425	+.10000	
PM7,12	-.12900	+.45800	+.00470	+.10799	
PM8,8	-.45500	+.78800	+.00682	+.11025	
PS9,48	-.15260	+.65890	+.00869	+.10000	
PS1045	+.00900	+.82829	+.01040	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10964	+.10000	+.11000	
PS2,B	+.11050	+.10000	+.11000	FAIL
PS3,D	+.03280	+.03100	+.03149	FAIL
PS4,20	+.01484	+.01520	+.01580	FAIL
PM5,11	+.09576	+.09450	+.09510	FAIL
PS6,22	+.13320	+.10000	+.13500	
PM7,12	+.13299	+.12500	+.13500	
PM8,8	+.11025	+.10000	+.11000	FAIL
PS9,48	+.01565	+.01629	+.01690	FAIL
PS1045	+.02594	+.02550	+.02610	

0003 - 0004 DIST = +.18970

C2

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46964	+.47345	+.44500	+.46500	FAIL
	+.21034	+.22200	+.22000	+.24000	
	+.47962				
	+.24034				
2-	+.41462	+.41462	+.40000	+.42200	
	+.24031	+.25946	+.27500	+.29500	FAIL
	+.41459				
	+.29031				
3-	+.35464	+.34412	+.33000	+.35000	
	+.21027	+.22064	+.21000	+.23200	
	+.33462				
	+.23026				
4-	+.34464	+.33766	+.32000	+.34000	
	+.20027	+.20027	+.19000	+.21000	
	+.32464				
	+.20026				
5-	+.39468	+.38604	+.37000	+.39000	
	+.13030	+.12158	+.11000	+.13000	
	+.37469				
	+.11029				

6-	-.47815	-.47815	-.57500	-.55500	FAIL
	+.37972	+.38815	+.37500	+.42000	
	-.47819				
	+.46412				
7-	-.47819	-.62565	-.75000	-.57500	
	+.46412	+.33510	+.30000	+.44800	
	-.47815				
	+.37972				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00232	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00193	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00305	+.01049	
PS6,22	-.07400	+.39700	+.00136	+.00399	
PM7,12	+.12900	+.45800	+.00155	+.01365	
PM8,8	+.45500	+.78800	+.00562	+.01777	
PS9,48	+.15260	+.65890	+.00489	+.00399	FAIL
PS1045	-.00900	+.82829	+.00387	+.00399	

C4

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10974	+.10000	+.11000	
PS2,B2	+.10988	+.10000	+.11000	
PS3,D2	+.03322	+.03100	+.03149	FAIL
PS4,20	+.01628	+.01520	+.01580	FAIL
PM5,11	+.09649	+.09450	+.09510	FAIL
PS6,22	+.13335	+.12500	+.13500	
PM7,12	+.13305	+.12500	+.13500	
PM8,8	+.10927	+.10000	+.11000	
PS9,48	+.01522	+.01629	+.01690	FAIL
PS1045	+.02511	+.02550	+.02610	FAIL

0003 - 0004 DIST = '+.18844

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85533	-.01000	-.00300	FAIL
	-.00599	-.13540	-.01000	-.00300	FAIL
		-.17000			
		-.17000			
2-		-.00250	-.00547	-.01000	-.00499
		-.00599	-.05497	-.04499	-.01000 FAIL
		-.01000			
		-.07000			

RUN

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01028	+.10000	
PS4,20	-.06430	+.34830	+.00786	+.10000	
PM5,11	+.52500	+.52500	+.01246	+.10132	
PS6,22	+.07400	+.39700	+.00393	+.10000	
PM7,12	-.12900	+.45800	+.00423	+.10795	
PM8,8	-.45500	+.76800	+.00706	+.11029	
PS9,48	-.15260	+.65890	+.00869	+.10000	
PS1045	+.00900	+.62829	+.00984	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10964	+.10000	+.11000	
PS2,B	+.11050	+.10000	+.11000	FAIL
PS3,D	+.03283	+.03100	+.03149	FAIL
PS4,20	+.01485	+.01520	+.01580	FAIL
PM5,11	+.09582	+.09450	+.09510	FAIL
PS6,22	+.13326	+.13000	+.13500	
PM7,12	+.13295	+.12500	+.13500	
PM8,8	+.11029	+.10000	+.11000	FAIL
PS9,48	+.01565	+.01629	+.01690	FAIL
PS1045	+.02600	+.02550	+.02610	

0003 - 0004 DIST = +.18952

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46958	+.47340	+.44500	+.46500	FAIL
	+.21047	+.22214	+.22000	+.24000	
	+.47957				
	+.24048				
2-	+.41457	+.41457	+.40000	+.42000	
	+.24045	+.25945	+.27500	+.29500	FAIL
	+.41454				
	+.29045				
3-	+.35458	+.34385	+.33000	+.35000	
	+.21042	+.22100	+.21000	+.23000	
	+.33457				
	+.23041				
4-	+.34458	+.33767	+.32000	+.34000	
	+.20041	+.20041	+.19000	+.21000	
	+.32458				
	+.20040				
5-	+.39462	+.38583	+.37000	+.39000	
	+.13044	+.12158	+.11000	+.13000	
	+.37463				
	+.11043				

D3

6-	-.47819	-.47819	-.57500	-.55500	FAIL
	+.37992	+.38634	+.37500	+.42000	
	-.47823				
	+.46432				
7-	-.47823	-.62569	-.75000	-.57500	
	+.46432	+.33530	+.30000	+.44800	
	-.47819				
	+.37992				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00230	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00212	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00305	+.01044	
PS6,22	-.07400	+.39700	+.00115	+.00399	
PM7,12	+.12900	+.45800	+.00164	+.01369	
PM8,8	+.45500	+.78800	+.00164	+.01815	
PS9,48	+.15260	+.65890	+.00521	+.00399	FAIL
PS1045	-.00900	+.82829	+.00387	+.00399	

DK

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10976	+.10000	+.11000	
PS2,B2	+.10995	+.10000	+.11000	
PS3,D2	+.03326	+.03100	+.03149	FAIL
PS4,20	+.01629	+.01520	+.01580	FAIL
PM5,11	+.09644	+.09450	+.09510	FAIL
PS6,22	+.13340	+.12500	+.13500	
PM7,12	+.13309	+.12500	+.13500	
PM8,8	+.10965	+.10000	+.11000	
PS9,48	+.01530	+.01629	+.01690	FAIL
PS1045	+.02519	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18833

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85539	-.01000	-.00300	FAIL
	-.00599	-.13557	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00533	-.01000	-.00499	
	-.00599	-.05512	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

RUN

E1

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.00978	+.10000	
PS4,20	-.06430	+.34830	+.00766	+.10000	
PM5,11	+.52500	+.52500	+.01230	+.10124	
PS6,22	+.07400	+.39700	+.00387	+.10000	
PM7,12	-.12900	+.45800	+.00458	+.10790	
PM8,8	-.45500	+.78800	+.00636	+.11027	
PS9,48	-.15260	+.65890	+.00869	+.10000	
PS1045	+.00900	+.82829	+.01005	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10963	+.10000	+.11000	
PS2,B	+.11031	+.10000	+.11000	FAIL
PS3,D	+.03284	+.03100	+.03149	FAIL
PS4,20	+.01490	+.01520	+.01580	FAIL
PM5,11	+.09574	+.09450	+.09510.	FAIL
PS6,22	+.13317	+.10000	+.13500	
PM7,12	+.13290	+.12500	+.13500	
PM8,8	+.11027	+.10000	+.11000	FAIL
PS9,48	+.01569	+.01629	+.01690	FAIL
PS1045	+.02603	+.02550	+.02610	

0003 - 0004 DIST = +.18941

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46944	+.47325	+.44500	+.46500	FAIL
	+.21033	+.22199	+.22000	+.24000	
	+.47942				
	+.24033				
2-	+.41442	+.41442	+.40000	+.42000	
	+.24030	+.25917	+.27500	+.29500	FAIL
	+.41440				
	+.29030				
3-	+.35444	+.34400	+.33000	+.35000	
	+.21027	+.22057	+.21000	+.23000	
	+.33443				
	+.23026				
4-	+.34444	+.33760	+.32000	+.34000	
	+.20027	+.20027	+.19000	+.21000	
	+.32444				
	+.20026				
5-	+.39447	+.38576	+.37000	+.39000	
	+.13029	+.12158	+.11000	+.13000	
	+.37448				
	+.11028				

6-	-.47834	-.47834	-.57500	-.55500	FAIL
	+.37978	+.38834	+.37500	+.42000	
	-.47838				
	+.46418				
7-	-.47838	-.62583	-.75000	-.57500	
	+.46418	+.33515	+.30000	+.44800	
	-.47834				
	+.37978				

E3

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00215	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00219	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00317	+.01045	
PS6,22	-.07400	+.39700	+.00123	+.00399	
PM7,12	+.12900	+.45800	+.00175	+.01361	
PM8,8	+.45500	+.78800	+.00355	+.01771	
PS9,48	+.15260	+.65890	+.00555	+.00399	FAIL
PS1045	-.00900	+.82829	+.00409	+.00399	FAIL

E4

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10977	+.10000	+.11000	
PS2,B2	+.10992	+.10000	+.11000	
PS3,D2	+.03329	+.03100	+.03149	FAIL
PS4,20	+.01632	+.01520	+.01580	FAIL
PM5,11	+.09645	+.09450	+.09810	FAIL
PS6,22	+.13337	+.12500	+.13500	
PM7,12	+.13301	+.12500	+.13500	
PM8,8	+.10921	+.10000	+.11000	
PS9,46	+.01530	+.01629	+.01690	FAIL
PS1045	+.02522	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18849

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85529	-.01000	-.00300	FAIL
	-.00599	-.13556	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00550	-.01000	-.00499	
	-.00599	-.05516	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

F1

RUN

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.00998	+.10000	
PS4,20	-.06430	+.34830	+.00766	+.10000	
PM5,11	+.52500	+.52500	+.01226	+.10124	
PS6,22	+.07400	+.39700	+.00387	+.10000	
PM7,12	-.12900	+.45800	+.00418	+.10786	
PM8,8	-.45500	+.78800	+.00653	+.11025	
PS9,48	-.15260	+.65890	+.00850	+.10000	
PS1045	+.00900	+.82829	+.00974	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10962	+.10000	+.11000	
PS2,B	+.11042	+.10000	+.11000	FAIL
PS3,D	+.03283	+.03100	+.03149	FAIL
PS4,20	+.01489	+.01520	+.01580	FAIL
PM5,11	+.09574	+.09450	+.09510	FAIL
PS6,22	+.13314	+.10000	+.13500	
PM7,12	+.13286	+.12500	+.13500	
PM8,8	+.11025	+.10000	+.11000	FAIL
PS9,48	+.01575	+.01629	+.01690	FAIL
PS1045	+.02602	+.02550	+.02610	

0003 - 0004 DIST = +.18946

F2

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46938	+.47320	+.44500	+.46500	FAIL
	+.21013	+.22186	+.22000	+.24000	
	+.47936				
	+.24013				
2-	+.41436	+.41436	+.40000	+.42000	
	+.24010	+.25896	+.27500	+.29500	FAIL
	+.41434				
	+.29010				
3-	+.35438	+.34416	+.33000	+.35000	
	+.21007	+.22022	+.21000	+.23000	
	+.33437				
	+.23006				
4-	+.34438	+.33762	+.32000	+.34000	
	+.20006	+.20006	+.19000	+.21000	
	+.32438				
	+.20006				
5-	+.39442	+.38571	+.37000	+.39000	
	+.13009	+.12138	+.11000	+.13000	
	+.37443				
	+.11008				

6-	-.47840	-.47840	-.57500	-.55500	FAIL
	+.37956	+.38834	+.37500	+.42000	
	-.47844				
	+.46396				
7-	-.47844	-.62589	-.75000	-.57500	
	+.46396	+.33493	+.30000	+.44800	
	-.47840				
	+.37956				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00230	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00232	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00332	+.01045	
PS6,22	-.07400	+.39700	+.00148	+.00399	
PM7,12	+.12900	+.45800	+.00178	+.01355	
PM8,8	+.45500	+.78800	+.00590	+.01767	
PS9,48	+.15260	+.65890	+.00544	+.00399	FAIL
PS1045	-.00900	+.82829	+.00387	+.00399	

F4

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10976	+.10000	+.11000	
PS2,B2	+.10991	+.10000	+.11000	
PS3,D2	+.03326	+.03100	+.03149	FAIL
PS4,20	+.01633	+.01520	+.01580	FAIL
PM5,11	+.09645	+.09450	+.09510	FAIL
PS6,22	+.13325	+.12500	+.13500	
PM7,12	+.13295	+.12500	+.13500	
PM8,8	+.10917	+.10000	+.11000	
PS9,48	+.01531	+.01629	+.01690	FAIL
PS1045	+.02527	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18842

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85525	-.01000	-.00300	FAIL
	-.00599	-.13586	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00554	-.01000	-.00499	
	-.00599	-.05548	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

RUN

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* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01048	+.10000	
PS4,20	-.06430	+.34830	+.00830	+.10000	
PM5,11	+.52500	+.52500	+.01282	+.10118	
PS6,22	+.07400	+.39700	+.00473	+.10000	
PM7,12	-.12900	+.45800	+.00459	+.10766	
PM8,8	-.45500	+.78800	+.00649	+.11017	
PS9,48	-.15260	+.65890	+.00923	+.10000	
PS1045	+.00900	+.82829	+.01019	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10960	+.10000	+.11000	
PS2,B	+.11023	+.10000	+.11000	FAIL
PS3,D	+.03278	+.03100	+.03149	FAIL
PS4,20	+.01484	+.01520	+.01580	FAIL
PM5,11	+.09568	+.09450	+.09510	FAIL
PS6,22	+.13303	+.10000	+.13500	
PM7,12	+.13266	+.12500	+.13500	
PM8,8	+.11017	+.10000	+.11000	FAIL
PS9,48	+.01563	+.01629	+.01690	FAIL
PS1045	+.02597	+.02550	+.02610	

0003 - 0004 DIST = +.18925

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46938	+.47334	+.44500	+.46500	FAIL
	+.20979	+.22181	+.22000	+.24000	
	+.47936				
	+.23979				
2-	+.41436	+.41436	+.40000	+.42000	
	+.23976	+.25912	+.27500	+.29500	FAIL
	+.41433				
	+.26976				
3-	+.35438	+.34415	+.33000	+.35000	
	+.20972	+.21980	+.21000	+.23000	
	+.33437				
	+.22971				
4-	+.34438	+.33747	+.32000	+.34000	
	+.19972	+.19972	+.19000	+.21000	
	+.32438				
	+.19970				
5-	+.39442	+.38586	+.37000	+.39000	
	+.12975	+.12111	+.11000	+.13000	
	+.37444				
	+.10973				

6-	-.47841	-.47841	-.57500	-.55500	FAIL
	+.37914	+.38778	+.37500	+.42000	
	-.47846				
	+.46354				
7-	-.47846	-.62592	-.75000	-.57500	
	+.46354	+.33452	+.30000	+.44800	
	-.47841				
	+.37914				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00216	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00195	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00322	+.01038	
PS6,22	-.07400	+.39700	+.00116	+.00399	
PM7,12	+.12900	+.45800	+.00143	+.01341	
PM8,8	+.45500	+.78800	+.00573	+.01757	
PS9,48	+.15260	+.65890	+.00555	+.00399	FAIL
PS1045	-.00900	+.82829	+.00395	+.00399	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10970	+.10000	+.11030	
PS2,B2	+.10980	+.10000	+.11000	
PS3,D2	+.03324	+.03100	+.03149	FAIL
PS4,20	+.01636	+.01520	+.01580	FAIL
PM5,11	+.09636	+.09452	+.09510	FAIL
PS6,22	+.13321	+.12500	+.13500	
PM7,12	+.13281	+.12500	+.13500	
PM8,8	+.10907	+.10000	+.11000	
PS9,48	+.01523	+.01629	+.01690	FAIL
PS1045	+.02519	+.02550	+.02610	FAIL

0003 - 0004 LIST = +.18829

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85529	-.01000	-.00300	FAIL
	-.00599	-.13592	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00550	-.01000	-.00499	
	-.00599	-.05559	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

RUN

H1

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01038	+.10000	
PS4,20	-.06430	+.34830	+.00830	+.10000	
PM5,11	+.52500	+.52500	+.01274	+.10111	
PS6,22	+.07400	+.39700	+.00469	+.10000	
PM7,12	-.12900	+.45800	+.00468	+.10755	
PM8,8	-.45500	+.78800	+.00635	+.11012	
PS9,48	-.15260	+.65890	+.00909	+.10000	
PS1045	+.00900	+.82829	+.01000	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10953	+.10000	+.11000	
PS2,B	+.10998	+.10000	+.11000	
PS3,D	+.03276	+.03100	+.03149	FAIL
PS4,20	+.01482	+.01520	+.01580	FAIL
PM5,11	+.09561	+.09450	+.09510	FAIL
PS6,22	+.13288	+.10000	+.13500	
PM7,12	+.13255	+.12500	+.13500	
PM8,8	+.11012	+.10000	+.11000	FAIL
PS9,48	+.01562	+.01629	+.01690	FAIL
PS1045	+.02596	+.02550	+.02610	

0003 - 0004 DIST = +.18937

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46929	+.47325	+.44500	+.46500	FAIL
	+.20969	+.22178	+.22000	+.24000	
	+.47928				
	+.23969				
2-	+.41428	+.41428	+.40000	+.42000	
	+.23966	+.25895	+.27500	+.29500	FAIL
	+.41425				
	+.28966				
3-	+.35429	+.34414	+.33000	+.35000	
	+.20962	+.21963	+.21000	+.23000	
	+.33428				
	+.22961				
4-	+.34430	+.33739	+.32000	+.34000	
	+.19962	+.19962	+.19000	+.21000	
	+.32430				
	+.19961				
5-	+.39434	+.38584	+.37000	+.39000	
	+.12964	+.12108	+.11000	+.13000	
	+.37435				
	+.10963				

6-	-.47849	-.47849	-.57500	-.55500	FAIL
	+.37905	+.38783	+.37500	+.42000	
	-.47854				
	+.46345				
7-	-.47854	-.62600	-.75000	-.57500	
	+.46345	+.33443	+.30000	+.44800	
	-.47849				
	+.37905				

#3

HOLE #	XTRUE	YTRUE	MEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.03100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00487	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00502	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00489	+.01035	
PS6,22	-.07400	+.39700	+.00406	+.00399	FAIL
PM7,12	+.12900	+.45800	+.00432	+.01344	
PM8,8	+.45500	+.78800	+.00285	+.01758	
PS9,48	+.15260	+.65890	+.00953	+.00399	FAIL
PS1045	-.00900	+.82829	+.00693	+.00399	FAIL

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10925	+.10000	+.11000	
PS2,B2	+.10966	+.10000	+.11000	
PS3,D2	+.03316	+.03100	+.03149	FAIL
PS4,20	+.01620	+.01520	+.01580	FAIL
PM5,11	+.09635	+.09450	+.09510	FAIL
PS6,22	+.13318	+.12500	+.13500	
PM7,12	+.13284	+.12500	+.13500	
PM8,8	+.10908	+.10000	+.11000	
PS9,48	+.01522	+.01629	+.01690	FAIL
PS1045	+.02517	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18814

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85567	-.01000	-.00300	FAIL
	-.00599	-.13612	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00498	-.01000	-.00499	FAIL
	-.00599	-.05557	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

* RUN

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01069	+.10000	
PS4,20	-.06430	+.34630	+.00822	+.10000	
PM5,11	+.52500	+.52500	+.01306	+.10100	
PS6,22	+.07400	+.39700	+.00505	+.10000	
PM7,12	-.12900	+.45800	+.00509	+.10738	
PM8,8	-.45500	+.78800	+.00663	+.10997	
PS9,48	-.15260	+.65890	+.00946	+.10000	
PS1045	+.00900	+.82829	+.01050	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10943	+.10000	+.11000	
PS2,B	+.10973	+.10000	+.11000	
PS3,D	+.03265	+.03100	+.03149	FAIL
PS4,20	+.01475	+.01520	+.01580	FAIL
PM5,11	+.09550	+.09450	+.09510	FAIL
PS6,22	+.13273	+.10000	+.13500	
PM7,12	+.13239	+.12500	+.13500	
PM8,8	+.10997	+.10000	+.11000	
PS9,48	+.01547	+.01629	+.01690	FAIL
PS1045	+.02590	+.02550	+.02610	

0003 - 0004 DIST = +.18955

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46932	+.47328	+.44500	+.46500	FAIL
	+.20972	+.22175	+.22000	+.24000	
	+.47931				
	+.23973				
2-	+.41431	+.41431	+.40000	+.42000	
	+.23969	+.25913	+.27500	+.29500	FAIL
	+.41428				
	+.28969				
3-	+.35432	+.34403	+.33000	+.35000	
	+.20965	+.21980	+.21000	+.23000	
	+.33431				
	+.22964				
4-	+.34433	+.33735	+.32000	+.34000	
	+.19965	+.19965	+.19000	+.21000	
	+.32433				
	+.19963				
5-	+.39437	+.38595	+.37000	+.39000	
	+.12966	+.12118	+.11000	+.13000	
	+.37438				
	+.10966				

6-	-.47847	-.47847	-.57500	-.55500	FAIL
	+.37905	+.38605	+.37500	+.42000	
	-.47852				
	+.46345				
7-	-.47852	-.62597	-.75000	-.57500	
	+.46345	+.33443	+.30000	+.44800	
	-.47847				
	+.37905				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78600	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00440	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00400	+.00120	FAIL
PMS,11	-.52500	+.52500	+.00463	+.01021	
PS6,22	-.07400	+.39700	+.00354	+.00399	
PM7,12	+.12900	+.45800	+.00425	+.01311	
PM8,8	+.45500	+.78800	+.00515	+.01726	
PS9,48	+.15260	+.65890	+.00869	+.00399	FAIL
PS1045	-.00900	+.82829	+.00641	+.00399	FAIL

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10903	+.10000	+.11000	
PS2,B2	+.10948	+.10000	+.11000	
PS3,L2	+.03304	+.03100	+.03149	FAIL
PS4,20	+.01613	+.01520	+.01580	FAIL
PM5,11	+.09621	+.09450	+.09510	FAIL
PS6,22	+.13283	+.12500	+.13500	
PM7,12	+.13251	+.12500	+.13500	
PM8,8	+.10876	+.10000	+.11000	
PS9,48	+.01522	+.01629	+.01690	FAIL
PS1045	+.02510	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18787

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85565	-.01000	-.00300	FAIL
	-.00599	-.13581	-.01000	-.00300	FAIL
		-.17000			
		-.17000			
2-		-.00250	-.00500	-.01000	-.00499
	-.00599	-.05545	-.04499	-.01000	FAIL
		-.01000			
		-.07000			

* RUN

J-1

* DATA

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A	+3.67749	+1.06299	+.00000	+.10000	
PS2,B	+.45500	+.78800	+.00000	+.10000	
PS3,D	+.00010	+.52500	+.01151	+.10000	
PS4,20	-.06430	+.34830	+.00659	+.10000	
PM5,11	+.52500	+.52500	+.21575	+.09638	
PS6,22	+.07400	+.39700	+.00461	+.10000	
PM7,12	-.12900	+.45800	+.00555	+.10551	
PM8,8	-.45500	+.78800	+.00764	+.10969	
PS9,48	-.15260	+.65890	+.00972	+.10000	
PS1045	+.00900	+.82829	+.01115	+.10000	

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A	+.10917	+.10000	+.11000	
PS2,B	+.10935	+.10000	+.11000	
PS3,D	+.03270	+.03100	+.03149	FAIL
PS4,20	+.01466	+.01520	+.01560	FAIL
PM5,11	+.09088	+.09450	+.09510	FAIL
PS6,22	+.13051	+.10000	+.13500	
PM7,12	+.13051	+.12500	+.13500	
PM8,8	+.10969	+.10000	+.11000	
PS9,48	+.01556	+.01629	+.01690	FAIL
PS1045	+.02592	+.02550	+.02610	

0003 - 0004 DIST = +.18943

—

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46952	+.47355	+.44500	+.46500	FAIL
	+.21031	+.22255	+.22000	+.24000	
	+.47950				
	+.24032				
2-	+.41453	+.41450	+.40000	+.42000	
	+.24027	+.25986	+.27500	+.29520	FAIL
	+.41447				
	+.29027				
3-	+.35452	+.34408	+.33000	+.35000	
	+.21023	+.22053	+.21000	+.23000	
	+.33451				
	+.23022				
4-	+.34453	+.33733	+.32000	+.34000	
	+.20023	+.20023	+.19000	+.21000	
	+.32453				
	+.20021				
5-	+.39458	+.38601	+.37000	+.39000	
	+.13026	+.12162	+.11000	+.13000	
	+.37459				
	+.11025				

6-	-.47828	-.47628	-.57500	-.55500	FAIL
	+.37956	+.38815	+.37500	+.42000	
	-.47834				
	+.46398				
7-	-.47834	-.62579	-.75000	-.57500	
	+.46398	+.33496	+.30000	+.44800	
	-.47828				
	+.37958				

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.00100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00506	+.00120	FAIL
PS4,20	+.06430	+.34830	+.00471	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00575	+.01001	
PS6,22	-.07400	+.39700	+.00331	+.00399	
PM7,12	+.12900	+.45800	+.00310	+.01114	
PM8,8	+.45500	+.78800	+.00324	+.01659	
PS9,48	+.15260	+.65890	+.00269	+.00399	
PS1045	-.00900	+.82829	+.00438	+.00399	FAIL

J-4

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10647	+.10000	+.11000	
PS2,B2	+.10902	+.10000	+.11000	
PS3,D2	+.03309	+.03100	+.03149	FAIL
PS4,20	+.01621	+.01520	+.01580	FAIL
PM5,11	+.09601	+.09450	+.09510	FAIL
PS6,22	+.13112	+.12500	+.13500	
PM7,12	+.13054	+.12500	+.13500	
PM8,8	+.10839	+.10000	+.11000	
PS9,48	+.01520	+.01629	+.01690	FAIL
PS1045	+.02503	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18838

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85579	-.01000	-.00300	FAIL
	-.00599	-.13496	-.01000	-.00300	FAIL
	-.17003				
	-.17000				
2-	-.00250	-.00508	-.01000	-.00499	
	-.00599	-.05466	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

K1

```
*
* RUN

* DATA
HOLE #    XTRUE     YTRUE     RMEAS     R-TOL    STATUS

PS1,A   +3.67749 +1.06299  +.00000  +.10000
PS2,B    +.45500  +.73800  +.00000  +.10000
PS3,D    +.00010  +.52500  +.01171  +.10000
PS4,20   -.36430  +.34830  +.00927  +.10000
PM5,11   +.52500  +.52500  +.01410  +.10000
PS6,22   +.07430  +.39700  +.00593  +.10000
PM7,12   -.12900  +.45800  +.00611  +.10714
PM8,8    -.45500  +.73800  +.00734  +.10971
PS9,48   -.15260  +.65890  +.01002  +.10000
PS1045   +.00900  +.82829  +.01094  +.10000


HOLE #  DIAMETER   LOWER     UPPER    STATUS

PS1,A    +.10929  +.10000  +.11000
PS2,B    +.10958  +.10000  +.11000
PS3,D    +.03259  +.03100  +.03149   FAIL
PS4,20   +.01471  +.01520  +.01560   FAIL
PM5,11   +.09535  +.09450  +.09510   FAIL
PS6,22   +.13250  +.10000  +.13500
PM7,12   +.13214  +.12500  +.13500
PM8,8    +.10971  +.10000  +.11000
PS9,48   +.01536  +.01629  +.01690   FAIL
PS1045   +.02574  +.02550  +.02610

0003  - 0004  DIST =    +.16943
```

K2

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+.46943	+.47332	+.44500	+.46500	FAIL
	+.20967	+.22170	+.22000	+.24000	
	+.47941				
	+.23968				
2-	+.41441	+.41441	+.40000	+.42000	
	+.23963	+.25936	+.27500	+.29500	FAIL
	+.41437				
	+.28963				
3-	+.35443	+.34392	+.33000	+.35000	
	+.20959	+.21996	+.21000	+.23000	
	+.33442				
	+.22958				
4-	+.34444	+.33724	+.32000	+.34000	
	+.19958	+.19958	+.19000	+.21000	
	+.32444				
	+.19957				
5-	+.39449	+.38621	+.37000	+.39000	
	+.12962	+.12127	+.11000	+.13000	
	+.37451				
	+.10960				

6-	-.47838	-.47838	-.57500	-.55520	FAIL
	+.37888	+.38774	+.37500	+.42000	
	-.47844				
	+.46328				
7-	-.47844	-.62590	-.75000	-.57500	
	+.46328	+.33426	+.30000	+.44800	
	-.47838				
	+.37888				

K3

HOLE #	XTRUE	YTRUE	RMEAS	R-TOL	STATUS
PS1,A2	-2.37500	+.30100	+.00000	+.00001	
PS2,B2	-.45500	+.78800	+.00000	+.00001	
PS3,D2	+.00010	+.52500	+.00635	+.00120	FAIL
PS4,20	+.06430	+.34630	+.00457	+.00120	FAIL
PM5,11	-.52500	+.52500	+.00563	+.01005	
PS6,22	-.07400	+.39700	+.00505	+.00399	FAIL
PM7,12	+.12900	+.45800	+.00542	+.01271	
PM8,8	+.45500	+.78800	+.00551	+.01722	
PS9,48	+.15260	+.65890	+.00275	+.00399	
PS1045	-.00900	+.82829	+.00470	+.00399	FAIL

K4

HOLE #	DIAMETER	LOWER	UPPER	STATUS
PS1,A2	+.10863	+.10000	+.11000	
PS2,B2	+.10695	+.10000	+.11000	
PS3,D2	+.03279	+.03100	+.03149	FAIL
PS4,20	+.01582	+.01520	+.01580	FAIL
PM5,11	+.09605	+.09450	+.09510	FAIL
PS6,22	+.13230	+.12500	+.13500	
PM7,12	+.13212	+.12500	+.13500	
PM8,8	+.10872	+.10000	+.11000	
PS9,48	+.01512	+.01629	+.01690	FAIL
PS1045	+.02479	+.02550	+.02610	FAIL

0003 - 0004 DIST = +.18874

LENG #	INIT.	LOC'N	LOWER	UPPER	STATUS
INTE	+1.00000	+.85532	-.01000	-.00300	FAIL
	-.00599	-.13553	-.01000	-.00300	FAIL
	-.17000				
	-.17000				
2-	-.00250	-.00547	-.01000	-.00499	
	-.00599	-.05505	-.04499	-.01000	FAIL
	-.01000				
	-.07000				

APPENDIX III

COMPARATOR GAGE OPERATION GUIDE

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COMP-GAGE OPERATION GUIDE

Operation of the COMP-GAGE is logical and uncomplicated. In general, normal conversational words are used to direct it through various learning and inspection stages.

The COMP-GAGE possesses core memory and uses paper tape and a teletype reader to acquire intelligence and perform analytical tasks.

Under normal operating conditions, the computer will retain its memory even with a loss of power, but if for any reason should the memory be lost, reloading the program is simple and follows these basic steps:

1. Place the power switch key to ON.
2. Move teletype reader switch to FREE.
3. Position program loader tape on the feed holes and thread into reader.
4. Position tape leader until loader tape feeds to just before the punched holes.
5. Place all numbered octal switches DOWN, and the teletype reader switch on START.
6. Set octal switch 12 UP.
7. Depress program load switch.
8. When the tape stops, remove tape and place tape reader switch to FREE. (Should the tape jam or foul while reading, depress STOP button, rearrange tape and depress CONTINUE switch to finish reading).
9. Place COMP-GAGE program tape in the reader and prepare it in the same manner as the loader tape.
10. When the tape is ready for reading, place all numbered octal switches in the up position except switch Ø and 1 (37777 octal) = 16 K) must be down.

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11. Depress START (tape will feed).

12. After tape is read and removed, load the next sequential COMP-GAGE program. If finished, go to step 13 and the COMP-GAGE system should be ready for operation. If not, load next tape and go to step 11.

IF TAPE STOPS check for 27 on readout. If there is no tape from start.

13. Place all octal switches down.

14. Place 7 and 10 octal switches up (440 octal).

COMP-GAGE is ready for operation.

ATRACE: A Trace

This command causes the scanning system to perform an A-Trace measurement horizontally across the center of the scanner's field. An oscilloscope must be used to monitor the X position vs B data intensity. As an example, scanning from right to left over an edge (light to dark) in a half white, half dark field, an A-Trace would appear as follows:

The sharper the transition slope, the better the focus. To exit, simply depress any teletype key and the prompt will return and the A-Trace will cease.

AUTO: Automatic Inspection Mode

This command automatically runs the currently trained instructions to perform the requested measurements any number of times on the inspection system. Once this command has been issued, the teletype will respond with AUTOMATIC INSPECTION. This tells the operator that the automatic mode is active. To start measuring, the operator must type the command RUN (see RUN COMMAND). The system will sequence through without interruption, initiating printouts as selected through the TYPE commands, and determining FAIL or PASS conditions on the present part. In order to exit this mode, simply block

the part so that light cannot pass through the datum holes and the system will return to the prompt. In order to delete AUTO operation, type MANUAL, and see MANUAL command instructions. SIDE1, SIDE2, MANUAL, BYPASS and AUTO are all related commands.

BYPASS: Bypass Instruction

This command is used for system checkout of the load sequence. After typing BYPASS, the system will respond with BYPASS "ON". The operator now types RUN. The system will now sequence as follows:

(1) Drive table to true HOME position.
(2) Drive table to initial set position for loading
(3) Waits until SIDE 1 ready initiates
(4) Retracts table
(5) Side 1 done pulses
(6) Side 1 OK
(7) Waits until Side 2 ready initiates
(8) Side 2 done
(9) Side 2 OK
(10) Prompt returns for operator

To exit the BYPASS mode, see RESET command.

Make sure ISET and RSET have been previously issued before using BYPASS.

CENTER: Center Boresight Cross

This command simply places a center marker cross on the monitor system or oscilloscope to physically center the boresight to some reference. Striking any teletype key exits back to the prompt.

CLOSE: Close Upper Laser Shutter

This command allows the operator to control the upper laser height measuring shutter through a teletype input. In this case, the shutter will close if opened or remain shut if closed. See OPEN command.

DATA: Data Output

This command allows the operator to typeout all the currently measured data from the last part measured. Only those items specifically trained for inspection will output. Upon completion the operator prompt (*) will return.

DEBUG: Debugger

This command allows the operator to enter the resident debug program. To operate this feature consult the Data General Debug II User's Manual 093-000020-03 for a complete description of system modification. This program provides for four active breakpoints within the user's program. The accumulators, carry, and memory locations can be examined and modified from the teletype. The machine state can be monitored during execution using simple commands. In addition, this program will punch ranges of memory in format acceptable as input to the binary loader and perform desk-calculator type expression evaluations. In order to exit back to your program from this routine type 44ØR. The prompt will be restored.

DIST1: Distance Analysis Side #1

This command allows the operator to output the currently measured distances for side #1 on the teletype. The return will be back to the operator prompt.

DIST2: Distance Analysis Side #2

Same as DIST 1 except for Side #2.

DRIVE: Drive XY-Table to Position

The DRIVE command allows teletype control of the XY-table movement as specified by the XYTABLE command.

FDATA1: Feature Data Side #1

This command allows feature data for a specific number to be analyzed. The operator issues FDATA1. The system responds with FEATURE #. Any number from 1 to 32 is allowed any other number greater than 32 or an alphanumeric will cause return to the operator prompt. All legal numbers are terminated by a carriage return. The selected output will then type out. The header information appears only once and the sequence of inputs will repeatedly occur until the operator wishes to exit this mode.

FDATA2: Feature Data Side 2

Same as for FDATA1 but now for Side 2.

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FLOC1: Feature Location Specification Side #1

This command allows the operator to input the starting and ending address of a feature line directly into the system memory. Upon typing this command, the system will respond with SIDE #1 FEATURE #. Any number from 1 to 32 is acceptable, all other number or characters will cause a return to the system prompt (*). After typing the number, type a carriage return. The system will respond with the following abbreviations:

SAX:	Starting address in X
SAY:	Starting address in Y
EAX:	Ending address in X
EAY:	Ending address in Y

After SAX: the system will print the present value followed by a comma. The new value is then input with either + or -, the decimal point need not be input for integer inputs, type only those numbers needed followed by a carriage return. The system will sequence through the same responses for SAY, EAX and EAY. If you should make an error while typing your new number, depress the RUBOUT key and then type in the new entire number. The RUBOUT key may be used an indefinite number of times on a line. If you do not want to modify an opened address, then simply strike the ESC key and the current contents will remain intact. Exit from this mode has been previously described.

These inputs are the two points between which the scanner will determine where the selected feature exists on the straight line between (SAX, SAY) and (EAX, EAY) coordinates.

FLOC2: Feature Location Side #2

This command is the same as FLOC1 except that inputs for side 2 are entered.

FTAG1: Feature Tag Side #1

This command allows the operator to select an alphanumeric tag for each feature input for easy measurement recognition on the printout. Any keyboard character is allowed except carriage return which terminates the input string of up to six characters. The preferred method of input is very simple. Upon typing, FTAG1, the system will respond with TAG ID #. Any number from 1 to 32 is legal. These numbers correspond to those selected when using FLOC1 or FLOC2 commands. After the number is input, follow it by a carriage return. The system will respond with:

NOW: XXXXXX NEW:

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The current tag is printed after NOW: and the system waits for a NEW: input from the teletype. Type in the new tag. If less than six characters, type spaces until the system prompts again. Any illegal number or key following the TAG ID # query will return the system prompt.

FTAG2: Feature Tag Side #2

Same as for FTAG1 except for side 2 printout tags.

HDATA1: Hole Data Location Analysis Side #1

Same as for FDATA1 except for holes instead of features for side 1.

HDATA2: Hole Data Location Analysis Side #2

Same as for FDATA1 except for holes instead of features for side 2.

HIGH#1: Height of Depth Control for Side #1

This command allows the operator to analyze features with the overhead laser to measure depths on the part surfaces. All features should be entered consecutively through the FLOC1 command. This command allows the operator to select where, after all features have been analyzed, the following features will be interpreted as depths with the use of the upper laser system. When this command is issued, the system responds with:

HEIGHT #1 COUNT BEGINS AT FEATURE #

The operator answers with the tag number where the depth measurements will occur followed by a carriage return. The numbers must be between 1 and 32. For no depth measuring type in 32. The system will return the prompt after the number is input.

HIGH#2: Height of Depth Control for Side #2

Same as for HIGH#1 command except Side 2 count is input.

HLOC1: Hole Center Location Side #1 Inputs

This command allows direct input of hole center locations to system memory. The system responds with HOLE # and waits

for a legal input as described previously in FLOC1. After a legal input, the system asks for XC and YC.

XC = X-center location
YC = Y-center location

After either XC or YC, the system will printout the current values resident therein and await a new input. (See FLOC1 for input discussion).

Any illegal number or alphanumeric answer to HOLE # will exit to the system prompt *. Holes 1 and 2 determine the datum line correction and must be entered before any system operation can occur.

HLOC2: Hole Center Location Side #2 Input

Same as for HLOC1 except for Side 2 inputs.

HOME: Home XY-Table Position

This command causes the XY-table to return to its home position.

HTAG1: Hole Tags Side #1

This command executes exactly like FTAG1 except that hole tags are input for Side #1.

P in first position governs printing of that line. An S or M in the second position designates the hole measurement types.

PS,#12 means print, S-hole #12

HTAG2: Hole Tags Side #2

Same as HTAG1 except for holes.

INITIAL: Initial Load Position

This command causes the XY-table to proceed to its initial position as specified through the ISET command. The initial position is initially set at point (1, 1) inches when the program is originally loaded.

ISET: Initial Set Position

The ISET command allows the operator to program the XY-table to an initial position for loading. The ISET command when issued takes the current values specified under the XYTABLE command or its current location to be saved permanently as an initial position. After this command is typed, the system response will be LOAD POINT SET, and return to the operator prompt *.

LOCATE: Locate Present XY-Table Position

This command causes the system to printout the current XY-table location.

MANUAL: Manual Mode

This command is used in conjunction with the AUTO command to allow one pass measurement of both sides and then stop for further commands. When this command is issued the system will respond with MANUAL INSPECTION, and return for more commands. This mode will remain set until the AUTO command is issued to change modes. The normal mode upon system initialization is manual at program read in time.

NORMAL: Normal XY-Table Operation

This command allows the XY-table to have its measurements referenced to true HOME position. When the system is initially read into memory, NORMAL is the usual mode.

OFFSET: Offset From Home Operation

This command allows the operator to not use the home position of the XY-table as a reference but another point on the table declared as (0, 0) offset from true home. The offset operation allows the operator to directly enter locations into the system memory from the part drawing. The only points that must be determined are the initial point and the location of the first datum hole with respect to the true home location. Once these are found, all other measurements will be relative to the first hole of each side. The system will respond with OFFSET "ON" when this command is issued.

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OPEN: Open Laser Shutter

This command causes the upper laser shutter to open and stay opened until either closed by the CLOSE command, or causing the XY-table to drive. The system does not print any response to this command but the shutter will open.

PUNCH: Punch Trained Information Parameters

This command allows paper tape punching of the trained information within the system for retraining the system, the exact same way at a later date. The PUNCH command is issued and the computer will halt allowing time for the operator to turn on the punch located at the left hand side of the teletype. If some leader is desired, place the teletype switch on LOCAL, turn punch on, depress the "HERE IS" key until the desired length is reached. Put teletype switch on "ON LINE". Depress the CONTINUE switch on the computer switches and the system will make a binary tape of the pertinent information. When completed, the computer will again halt. Turn off the punch and depress CONTINUE. The system prompt * will return.

If the operator desires to stop punching at anytime, placing Bit Ø "ON" via the panel switches will cause the system to return to the operator prompt. The system will return only after the current data block is finished punching.

RDOS: RDOS Return (RDOS ONLY)

This command allows the operator to return to an RDOS operating system. The operator must then hit CTRL-A or CTRL-C for exiting. This program command will appear to make the system inoperative in an SOS environment. Just STOP and START the program again.

READ: Read Binary Tapes Into System

This command allows the operator to read binary tapes via the teletype reader. The NOVA program loader must be resident. Load the binary tape into the reader, set SW = 37777, type READ, and the system will automatically read the binary tape and halt when finished. Place the starting address of this program on the NOVA switches ($44\emptyset_8$) and depress START. The system is again operative with the new information just read in present.

RESET: Reset Bypass Switch Mode

This command causes the BYPASS mode command to be reset for normal measurement operation. After issuing this command, the system responds with BYPASS "OFF" and returns the prompt. See the BYPASS command for initialization and operation of this mode.

RETRACT: Retract XY-Table

This command should be issued only after RSET has been initialized. After this command is issued, the system will respond with no confirmation but the XY-table will proceed to the preset retract point for part manipulation. The system prompt will automatically return when retraction is complete. See XY-table command and RSET for setting this position.

RETRAIN: Retrain Datum Line Angles

This command causes the system to reset all datum calculations for positioning to zero, and allows the operator to make another or new pass with new datum corrections. The system will respond with ANGLES RESET.

RSET: Retract Point Set

This command operates exactly like ISET except the retraction point is set and the system will respond with RETRACT SET. See ISET for transferring values from XYTABLE via RSET.

RUN: Run Mode

This command starts the measuring sequence:

(1) XY-table goes to home
(2) XY-table goes to ISET position
(3) Waits for ready signal for Side 1
(4) Moves to first datum hole
(5) Measures the center and four diameters
(6) Moves to second datum hole and does (5)
(7) Computes datum line angle and position
(8) Measures all remaining holes
(9) Measures all remaining features
(10) Measures all remaining depths

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Schlumberger

(11) Outputs information if desired
(12) Retracts to RSET position
(13) Gives out side 1 OK or fail signal and side 1 done
(14) Wait for side 2 ready signal
(15) Repeats steps (4) to (11) except for side 2 data
(16) Repeats steps (13) and (14) except for side 2 data
(17) If in manual mode, the system returns to *
(18) If in automatic mode, go to (1)

The system will also return to itself if an error message is encountered.

SCAN: Scan 256 x 256 Real Time Raster

This command allows the operator to cause the scanning system to display a real-time picture of the scanning area on an oscilloscope or monitor for visual verification. The scanners rate is 5 frames/sec. with 256 x 256 points/frame. To exit this mode, the operator simply depresses any teletype key. The system prompt will then appear as the scanning stops.

SIDE1: Side 1 Start

This command simply allows Side 1 measurements to immediately start with *no* initial *position* movement or external signalling. The program will measure Side 1 and then wait for signalling for Side 2.

SIDE2: Side 2 Start

This command directly runs Side 2 measurements with no external signalling and returns to the system prompt when completed.

STOP! Stop Program

Issuing this command will cause a total program halt. To return, simply depress the console *CONTINUE* switch. The system is now again operational.

TDIA1: Tolerance Diameter Side 1

When this command is issued, the system will respond with HOLE SIDE #1 TOL. # and await for a number from 1 to 32 followed by a carriage return. Any other character will exit to the system prompt. If a legal number is typed, the

operator may now type the lower and upper tolerances on that hole diameter number. The inputs are the same as those described previously under FLOC1.

TDIA2: Tolerance Diameter Side 2

Same as TDIA1 except for Side 2.

T4DIA1: Tolerance 4 Diameter Holes for Side 1

This command allows separate inputs for 4 diameter tolerance analysis on holes 1, 2, 3 and 4. Each diameter, taken at 45° from each other, are individually toleranced against this input tolerance. This command responds with HOLE 4-DIA TOL# and awaits for a 1 to 32 input followed by a carriage return. Inputs are the same as for TDIA1.

T4DIA2: Tolerance 4 Diameter Holes for Side 2

This command is exactly the same as T4DIA1 except for Side 2 measurements.

TFLOC1: Tolerance Feature Location Side 1

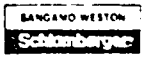
This command allows the operator to enter feature tolerances to both the X and Y position of the feature coordinate. The system will respond with FEATURE SIDE #1 TOL# and await for a 1 to 32 input with a carriage return. The system will respond with X-LOW: +X.XXXXX, and await inputs as discussed in FLOC1. After this number is input, the system will sequence through X-HIGH:, Y-LOW:, and Y-HIGH:. To exit simply type any key that is an illegal answer to the first query.

TFLOC2: Tolerance Feature Locations Side 2

This command allows inputs the same way as for TFLOC1 excepot for Side 2 features.

THLOC1: Tolerance Hole Locations Side 1

This command is exactly the same as TFLOC1 except the first prompt will be HOLE SIDE #1 TOL# and all other inputs are the same as for the features except now they correspond to hole center positions.



THLOC2: Tolerance Hole Locations Side 2

This command is exactly the same as THLOC1 except for Side 2 measurement hole center locations.

TYPE: Type Output Analysis

This command sets all printouts to be operable and the system will answer with PRINTING "ON", and return to the system prompt.

TYPED: Type Distance Data

This command allows distance printing only. The system will respond with PRINTING "ON".

TYPEF: Type Diameter Data

This command allows all diameter measurements to be printed. System will respond with PRINTING "ON".

TYPEH: Type Hole Data

This command allows all hole data locations and diameters to be printed out. The system will respond with PRINTING "ON".

TYPEL: Type Feature Location Data

This command allows selective typing of all feature data. The system will respond with PRINTING "ON".

TYPE 4: Type 4 Diameter Analysis

This command allows all 4 diameter tolerance analysis to be typed. The system will respond with PRINTING "ON".

TYPEN: Type Nothing

TYPEND: Type No Distance Analysis

TYPENF: Type No Diameter Analysis

TYPENH: Type No Hole Analysis

TYPENL: Type No Feature Analysis

TYPEN4: Type No 4 Dia. Analysis

All of the previous commands cause the teletype printouts to be inactive. Their corresponding initializations were previously discussed. The system will respond with PRINTING "OFF".

XY-TABLE: XY-Table Position Input

This command allows the operator to enter the coordinate position, in inches, that the XY-table should be moved to before making any measurements. Simply enter the values as prompted and terminate them with a carriage return. (See DRIVE, ISET and RSET)

ZERO

This command allows the operator to use any point on the XY-table to be a zero or home reference (Ø, Ø). If, however, HOME is issued this reference is set equal to the true home position.

OPERATING AND ROUTINE COMMANDS

;* ATRACE	DO A MANUAL A-TRACE
;* AUTO	AUTOMATIC OPERATION MODE
;* BYPASS	BYPASS INSPECTION
;* CENTER	CENTER BORESIGHT CROSS
;* CLOSE	CLOSE LASER SHUTTER
;* DATA	ANALYZES DATA FORMAT
;* DEBUG	ENTERS EMR TTY DEBUG 1
;* DIST 1	ANALYZE DISTANCES SIDE #1
;* DIST2	ANALYZE DISTANCES SIDE #2
;* DRIVE	DRIVE XY-TABLE TO POSITION
;* FDATA1	FEATURE DATA SIDE #1
;* FDATA2	FEATURE DATA SIDE #2
;* FLOC1	FEATURE LOCATION SIDE #1
;* FLOC2	FEATURE LOCATION SIDE #2
;* FTAG1	FEATURE TAG SIDE #1
;* FTAG2	FEATURE TAG SIDE #2
;* HDATA1	HOLE DIMENSION ANALYSIS SIDE #1
;* HDATA2	HOLE DIMENSION ANALYSIS SIDE #2
;* HIGH#1	SIDE #1 DEPTH CONTROL SWITCH
;* HIGH#2	SIDE #2 DEPTH CONTROL SWITCH
;* HLOC1	ENTER HOLE CENTERS SIDE #1
;* HLOC2	ENTER HOLE CENTERS SIDE #2
;* HOME	HOME XY-TABLE POSITIONING
;* HTAG1	HOLE TAG SIDE #1
;* HTAG2	HOLE TAG SIDE #2
;* INITIAL	INITIAL LOAD POSITION
;* ISET	INITIAL POINT SET
;* LOCATE	LOCATE XY-TABLE POSITION
;* MANUAL	MANUAL OPERATION MODE
;* NORMAL	NORMAL TABLE OPERATION
;* OFFSET	TABLE OFFSET CONTROL
;* OPEN	OPEN LASER SHUTTER
;* PUNCH	PUNCH TRAINING INSTRUCTION
;* RDOS	RDOS (DISK OPERATING SYSTEMS ONLY)
;* READ	READ INPUT TAPES MADE BY PUNCH
;* RESET	RESET TO AUTO MODE
;* RETRACT	RETRACT FOR FLIP/FLOP OF PART
;* RETRAIN	RETRAIN DATUM LINE ANGLES
;* RSET	RETRACT SET
;* RUN	EXECUTE PROGRAM ANALYSIS
;* SCAN	RASTER SCAN (256 x 256)
;* SIDE1	START AT SIDE ONE

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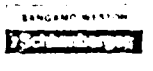
```
;* SIDE2                    START AT SIDE TWO
;* STOP!                    STOP ALL EXECUTION OF PROGRAM
;* TDIA1                    ENTER SIDE #1 DIAMETER TOL'S
;* TDIA2                    ENTER SIDE #2 DIAMETER TOL'S
;* T4DIA1                   ENTER SIDE #1 4-TOL DIAMETERS
;* T4DIA2                   ENTER SIDE #2 4-TOL DIAMETERS
;* THLOC1                   ENTER HOLE LOC. TOL'S SIDE #1
;* THLOC2                   ENTER HOLE LOC. TOL'S SIDE #2
;* TFLOC1                   ENTER FEATURE TOLERANCES SIDE #1
;* TFLOC2                   ENTER FEATURE TOLERANCES SIDE #2
;* TYPE                     PRINT ALL DATA ANALYSIS
;* TYPED                    TYPE DISTANCE DATA
;* TYPEF                    TYPE DIAMETER DATA
;* TYPEH                    TYPE HOLE DATA
;* TYPEL                    TYPE LENGTH DATA ANALYSIS
;* TYPE4                    TYPE FOUR DIA'S ANALYSIS
;* TYPEN                    TYPE NOTHING
;* TYPEND                   TYPE NO DISTANCE ANALYSIS
;* TYPENF                   TYPE NO DIAMETER ANALYSIS
;* TYPENH                   TYPE NO HOLE ANALYSIS
;* TYPENL                   TYPE NO LENGTH ANALYSIS
;* TYPEN4                   TYPE NO DIA'S FAILURES
;* XYTABLE                  XY-TABLE INPUT
;* ZERO                     ZERO CURRENT XY-TABLE REF POINT
```



APPENDIX IV

M577 LAMINA FIXTURE
DRAWINGS

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY, INC

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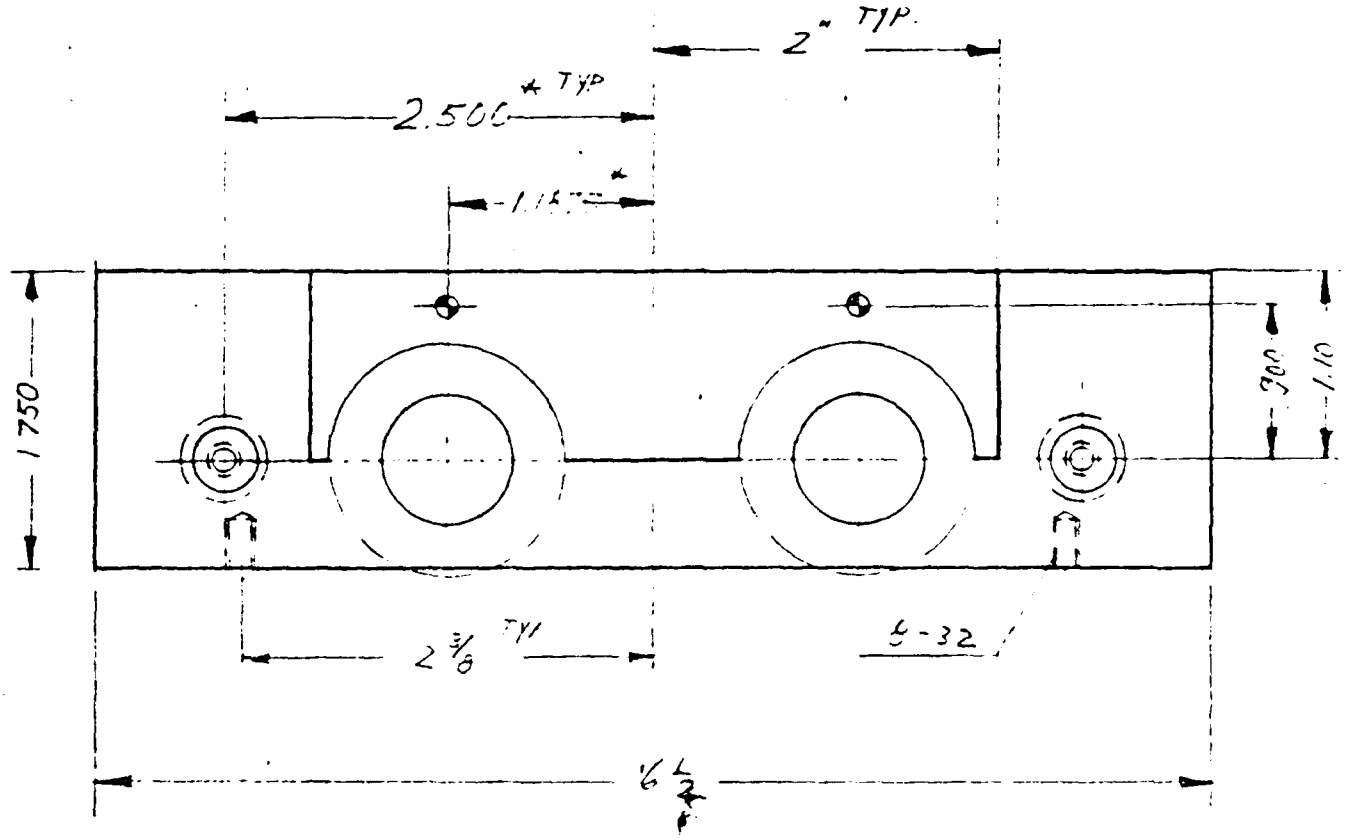
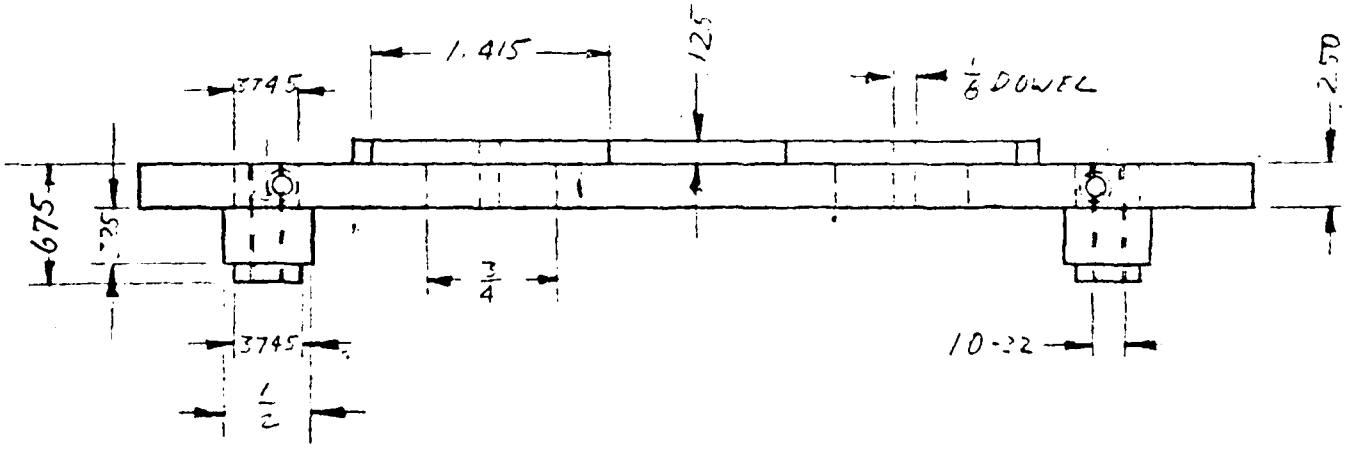
CHKD. BY_____ DATE_____ JOB NO._____





2 PCS REQ

FEB 29 1980

PART NO 9236553

PART NO 9236527

P.O.# 929

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY INC.

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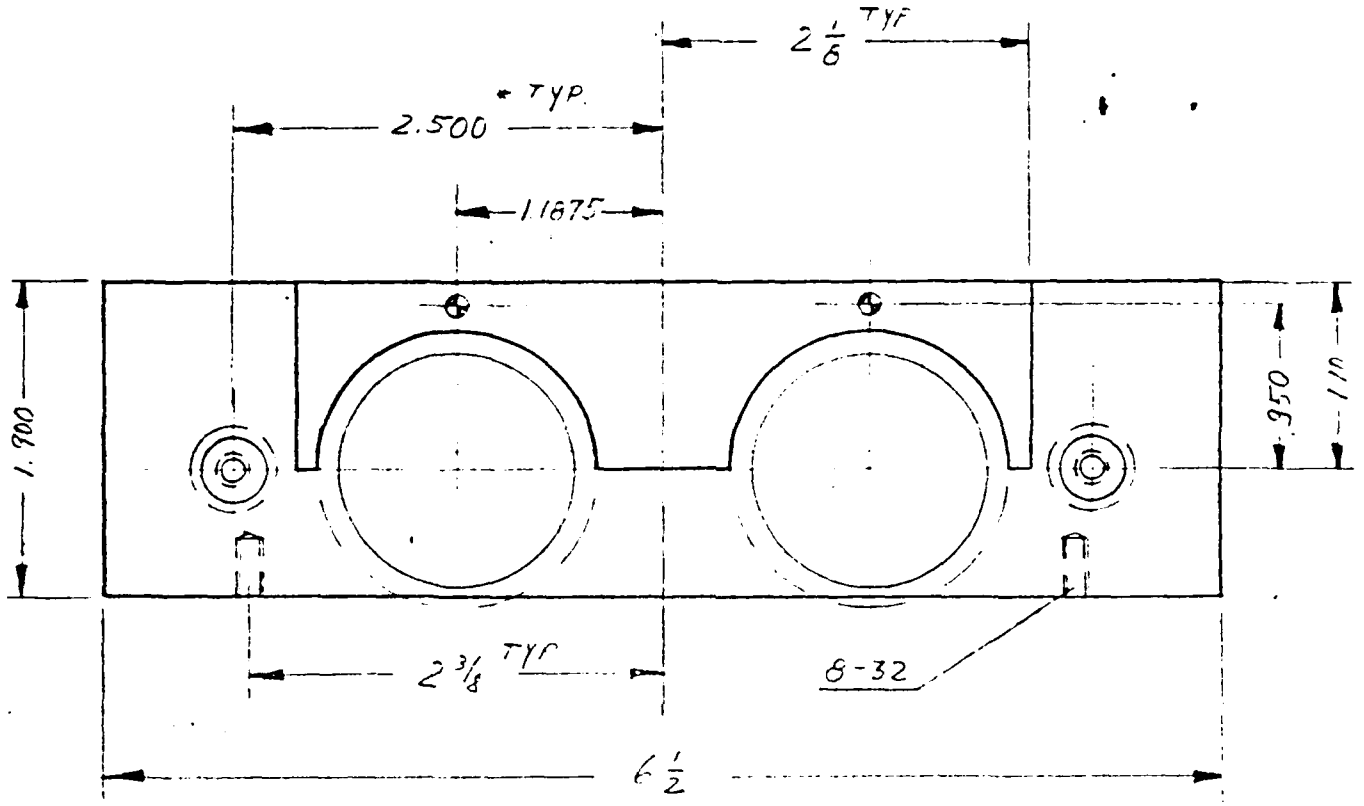

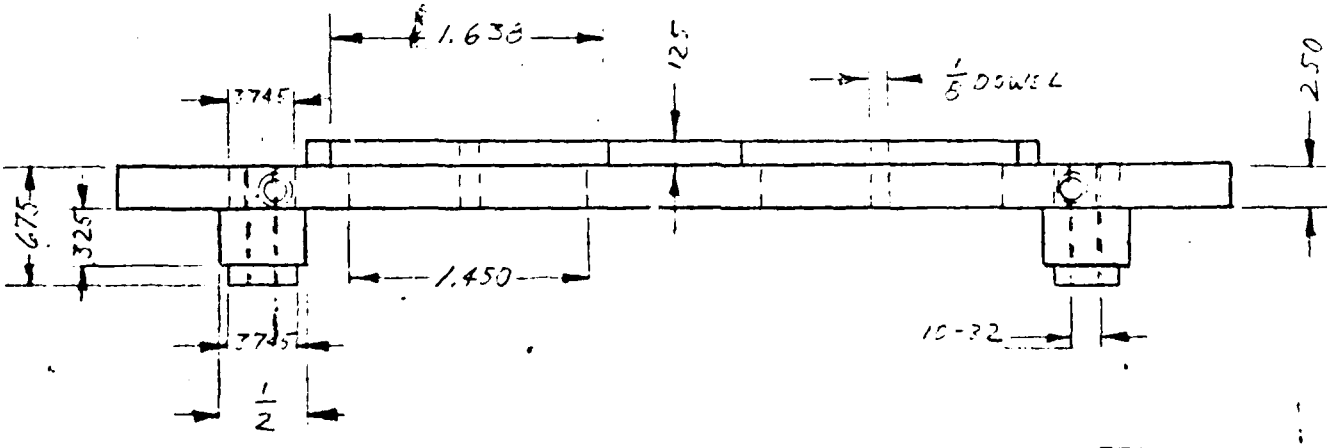

FEB 29 1980

FOR PART NO : 9236608

PROJ 729

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY INC

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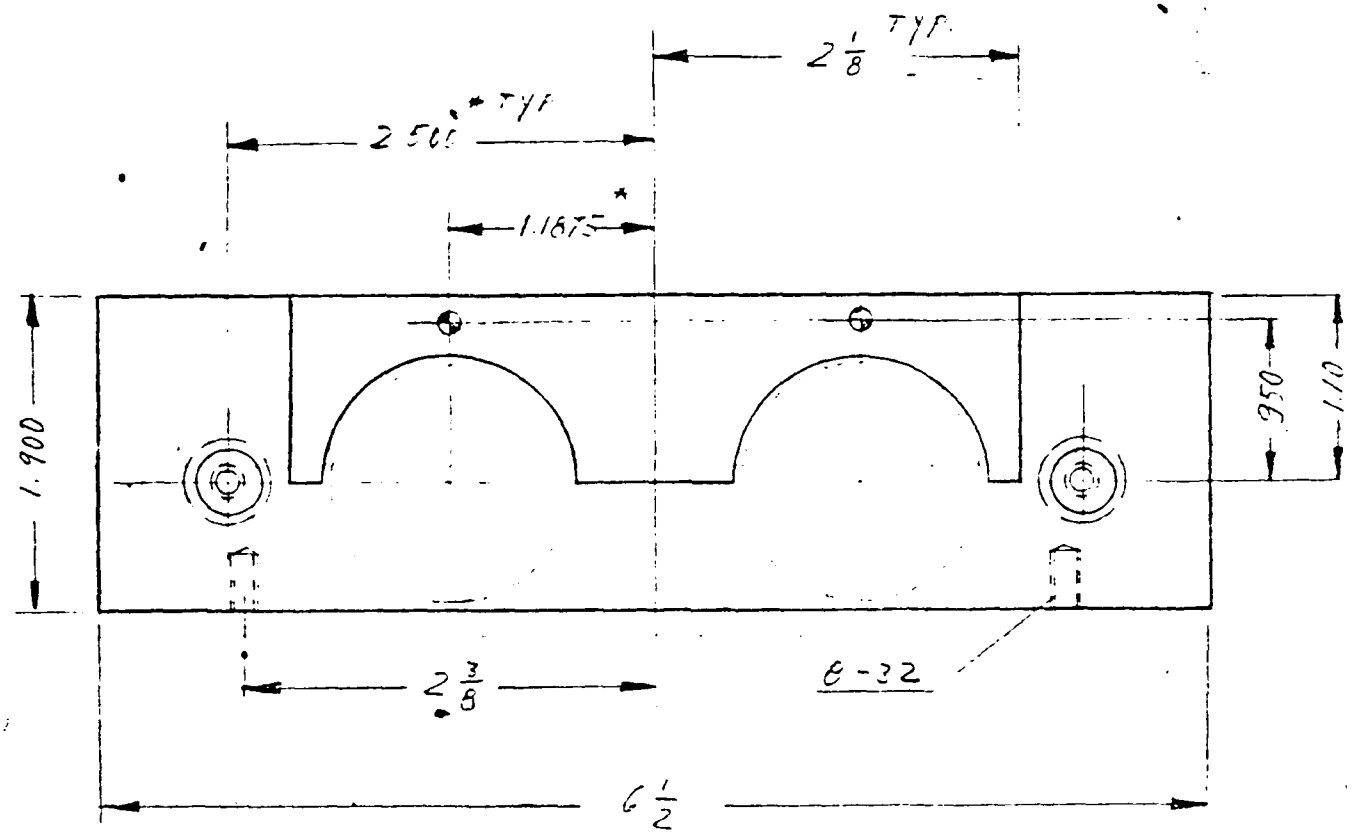

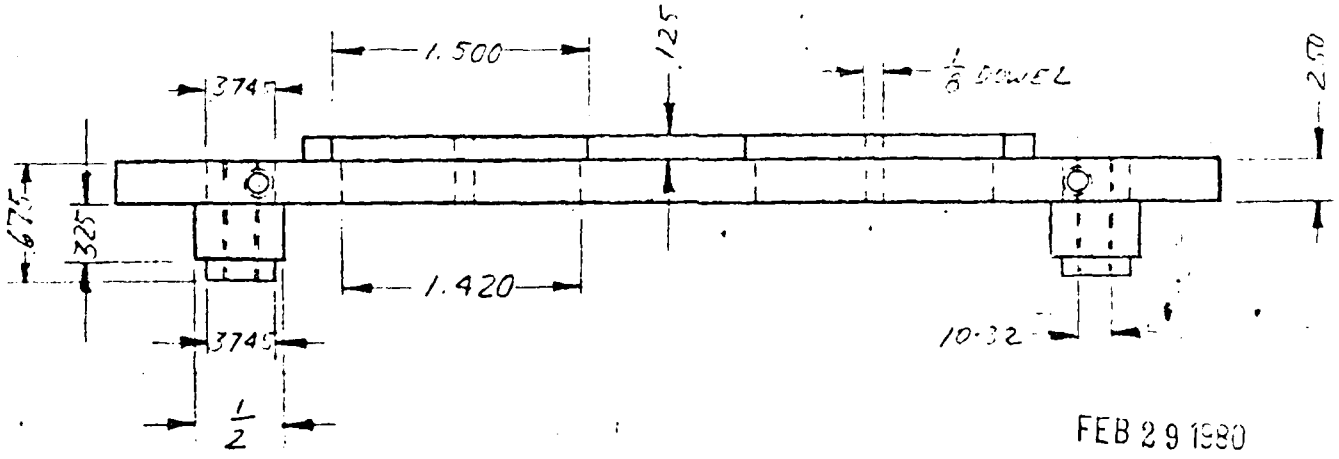

FEB 29 1980

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INS 929

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY INC

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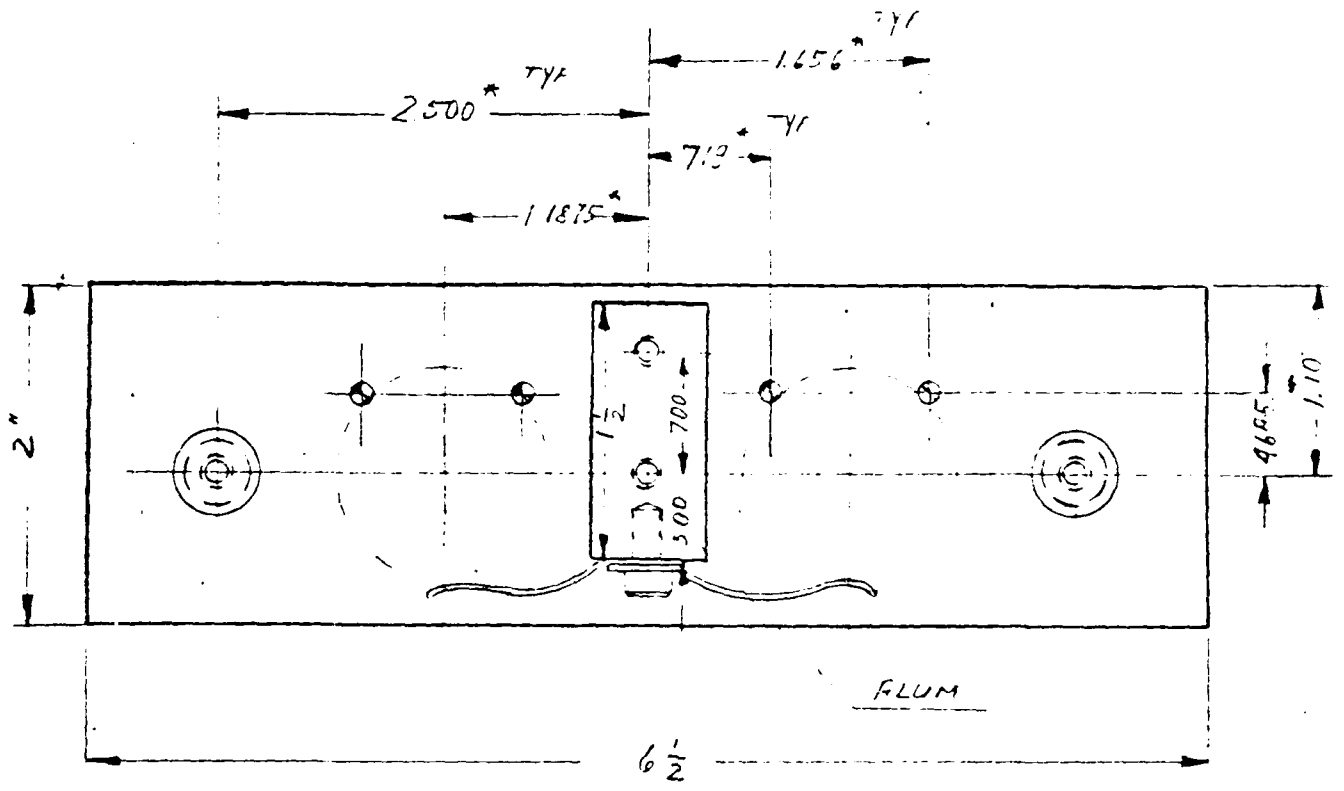
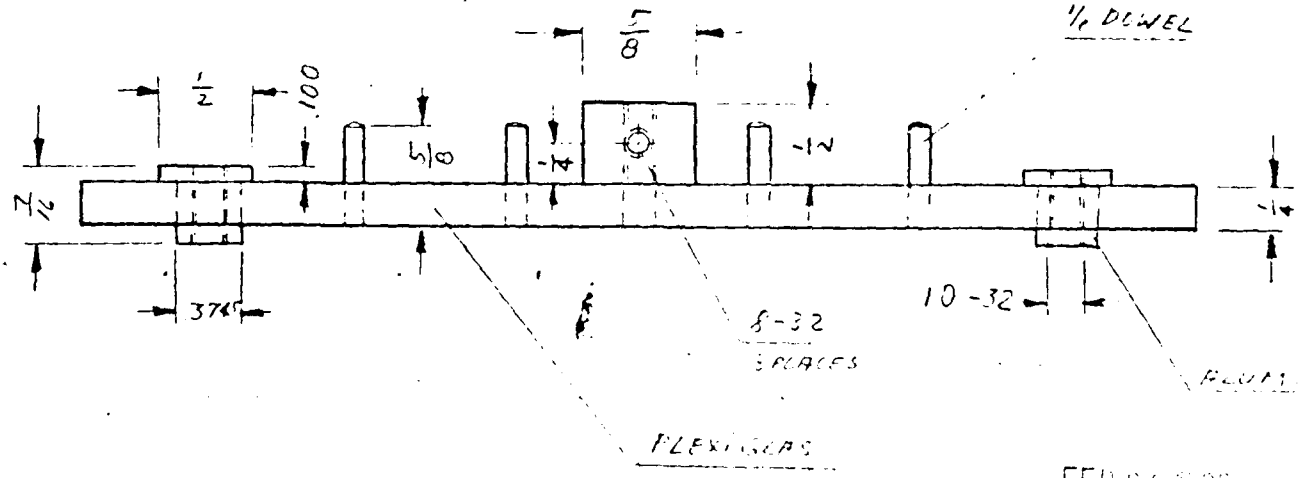
CHKD. BY_____ DATE_____ JOB NO._____





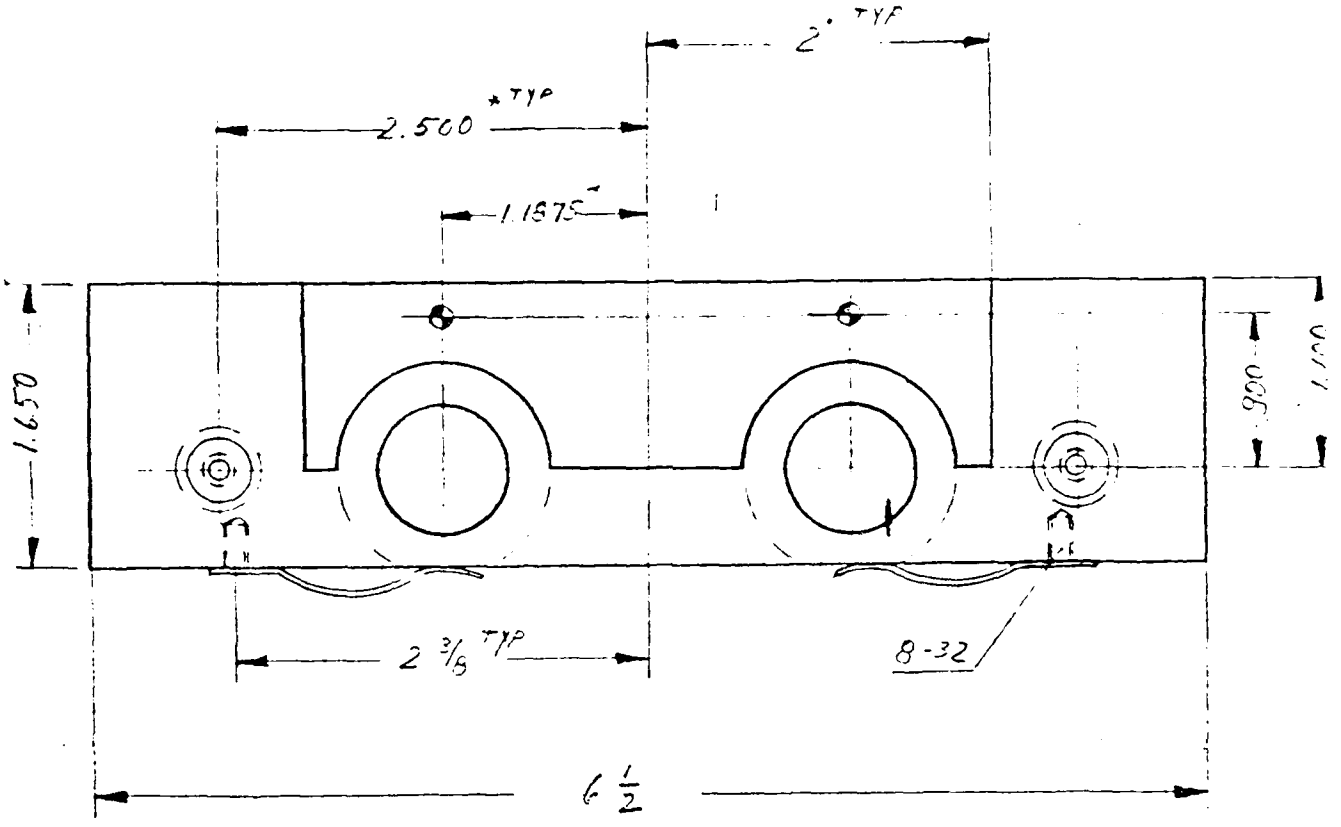
FEB 29 1988

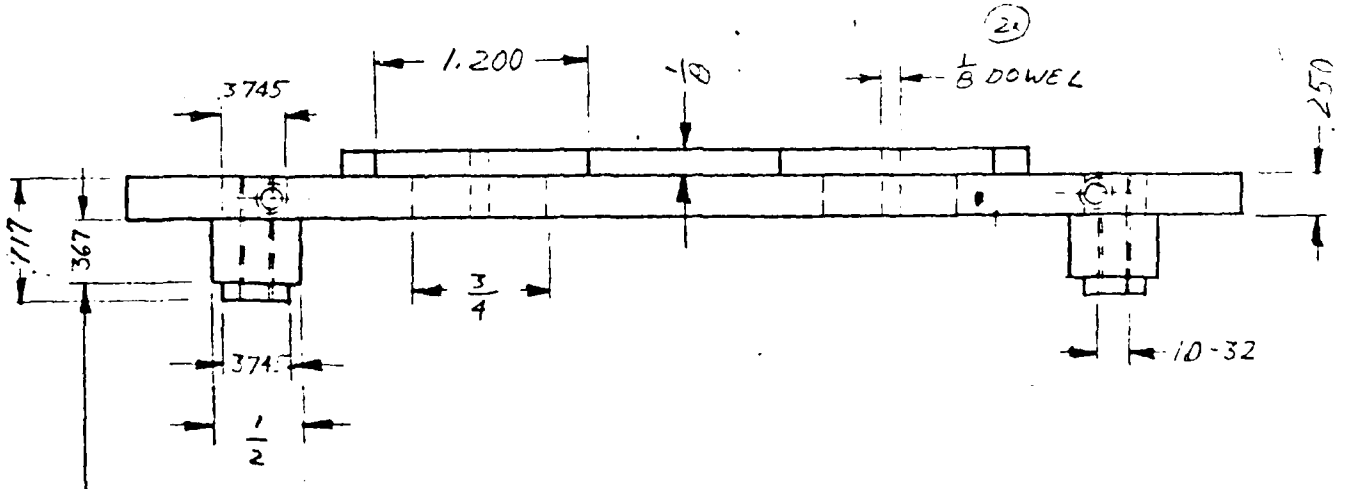
FOR PART
NO 9236636
PROJ 927

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY, INC.

BY_____ DATE _____ SUBJECT _____ SUBJECT NO. _____ OF _____

CHKD. BY_____ DATE _____ JOB NO. _____





.367 DIM FOR PART NO 123669

.307 DIM FOR PART NO : 9236681

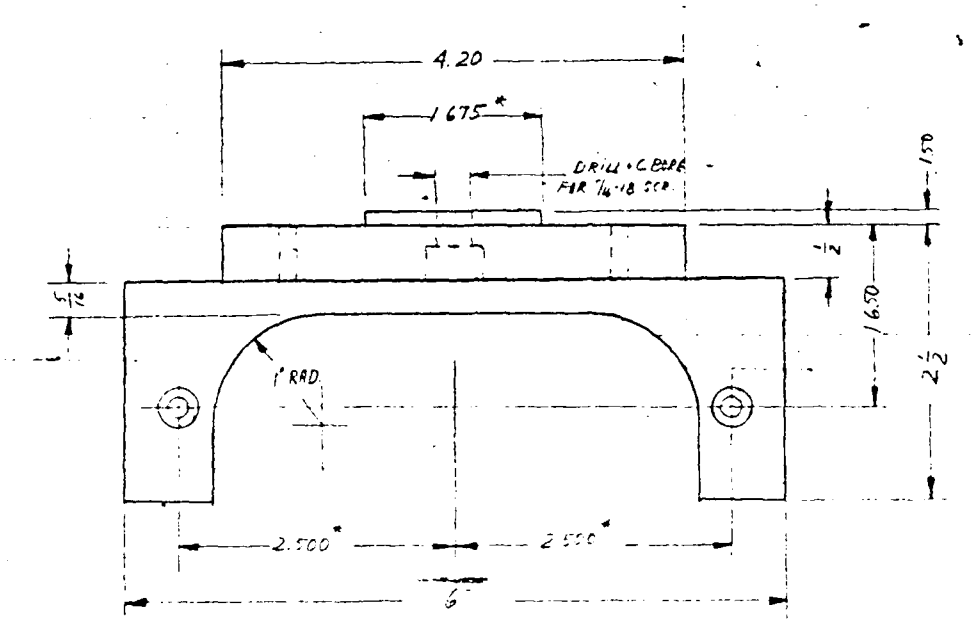
2 PCS REQ.
FEB 29 1980

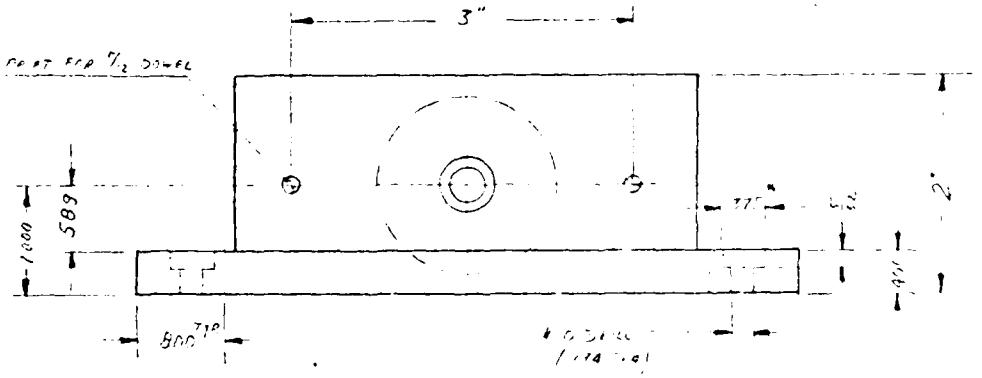
PROJ. 929

P 10354

SYSTEMS & INSTRUMENTS DIVISION
BULOVA WATCH COMPANY INC.

DATE
CHKD BY DATE
SUBJECT
SHEET NO
JOB NO





FEB 2 9 1980

AD-A115 951 BULOVA SYSTEMS AND INSTRUMENTS CORP VALLEY STREAM N Y F/G 14/2
FEASIBILITY STUDY OF ADAPTATION OF AUTOMATIC NON-CONTACT INSPEC--ETC(U)
JUN 79 M BRAVERMAN DAAA25-76-C-0344
UNCLASSIFIED NL

2 OF 2
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115 951

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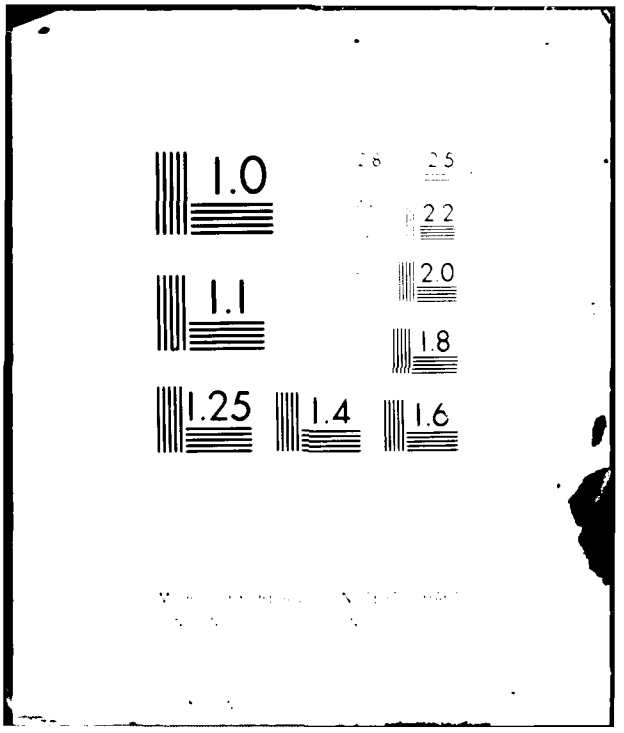
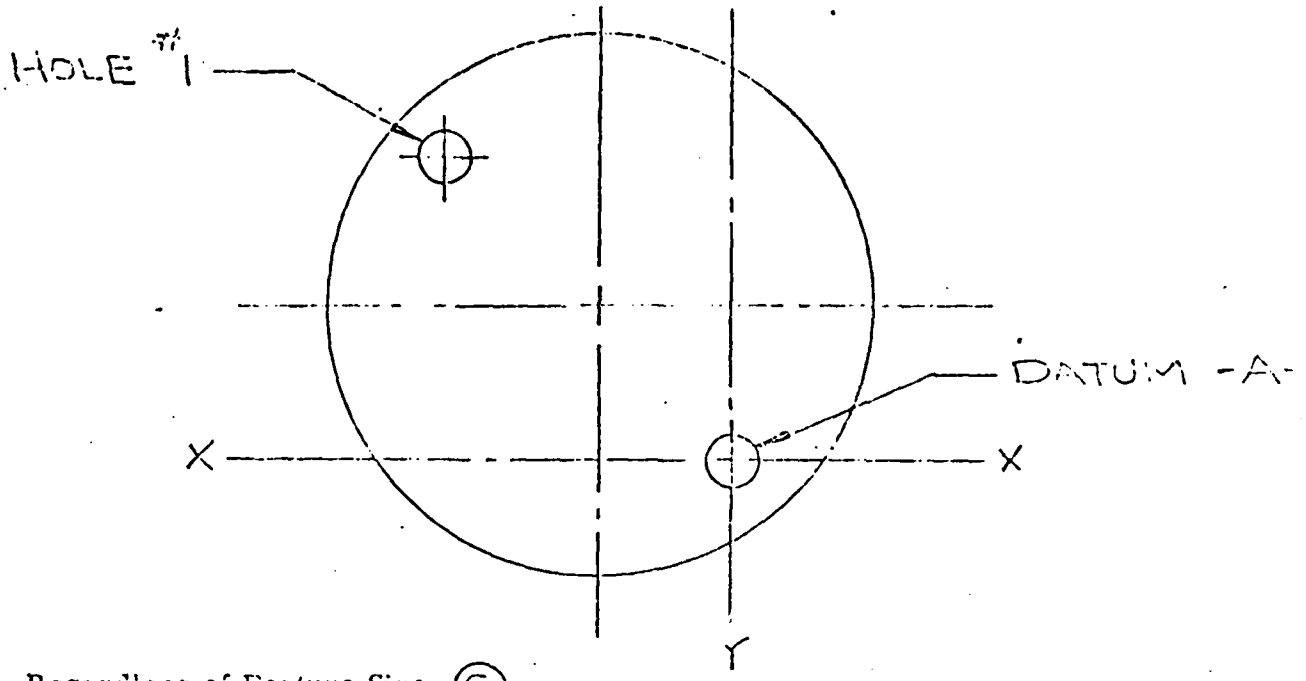

1.0
1.1
1.25
1.4
1.6
2.2
2.0
1.8

APPENDIX V

TRUE POSITION TOLERANCE

True Position Tolerance Considerations

The inspection machine has the capability of allowing position tolerance conditions to be satisfied in accordance with two standard acceptance techniques. An "S" or an "M" feature designation is selectable by proper input instructions with the HTAG1" and "HTAG2" the system commands for the 2 nests which accept the top and bottom surfaces respectively of the test specimen. The following two measurements Regardless of Feature Size "S" and Maximum Material "M" are described in the following two pages.



Regardless of Feature Size (S)

Step 1 Measure hole size of Datum-A-. If within hole tolerance, proceed.

Step 2 Center hole.

Step 3 Move to hole #1.

Step 4 Measure hole size of hole #1. If within hole tolernace, proceed.

Step 5 Center hole #1.

Step 6 Measure X&Y co-ordinates

Step 7 Compare with data for nominal position.

Step 8a) If data in step 7 is same as nominal data record X&Y co-ordinates in Step 6.

Step 8b) If data in step 7 is different than nominal data do the following:

Take difference of X&Y co-ordinates and calculate true position

$$Z=2\sqrt{X^2 + Y^2}$$

Step 8c) Compare Z in step (8b) with drawing true position tolerance.

Maximum Metal (M)

Step 1 Measure hole size of Datum-A-. If within hole tolerance, proceed.

Step 2 Center hole.

Step 3 Move to hole #1.

Step 4a) Measure hole size of hole 1. If within hole tolerance record actual size and proceed.

Step 4b) Add difference between min dwg size and actual hole size to positional tolerance.

Step 5 Center hole 1

Step 6 Measure X&Y co-ordinates.

Step 7 Compare with data for nominal position.

Step 8a) If data in step 7 is same as nominal data record X&Y co-ordinates in Step 6.

Step 8b) If data in step 7 is different than nominal date do the following:

Take difference of X&Y co-ordinates and calculate true position (Z)

$$Z=2\sqrt{X^2 + Y^2}$$

Step 8c) Compare Z in step (8b) with (Step 4b) true position tolerance.

Example #12 Hole

	Hole	X	Y	Posn. Tol.	Hole Size	Diff. of Hole Size
DWG REQ'T	12	.2285	.7559	.0056 M	$.143 \pm .005$ / $.000$	
ACTUAL	12	.2288	.7556	Z=.00085	.1462	.0032

1-Check hole Dia. (.1462)

2-Add difference between drawing (MIN) nominal hole size and actual hole size to drawing position tolerance. (.0032 + .0056=.0088)

3-Compute actual position tolerance (Z)=.00085

APPENDIX V1

HOLE AND FEATURE MEASUREMENT TECHNIQUES

GENERAL

All linear measurements are made using a software program which causes a line scan across any selected area of a part. As the scanning point passes through an intercept on the part being inspected, this intercept is stored as a digital address in the computer memory. After this single line scan is complete, the computer calculates the straight line distance between two points or intercepts of interest and displays or stores this dimensional information in units of inches or millimeters as calibrated.

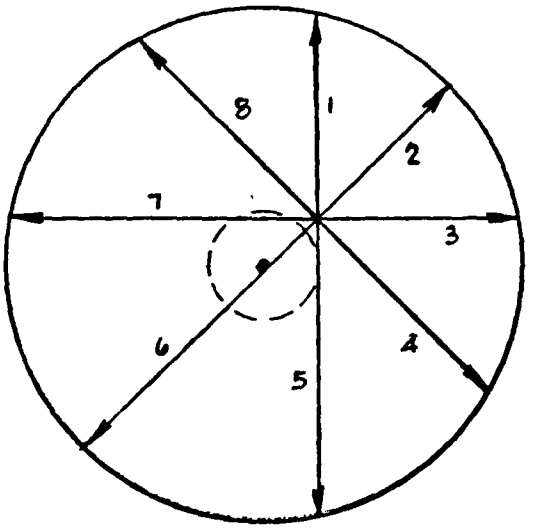
An intercept is a transition from a light area to a dark area. Two intercepts are needed to form the length of a line by calculating the straight line distance between the transition points. Any edge or transition may be defined as a feature. A combination of transitions may also be defined as components of a feature. Each component must have assigned limits for tolerance determination. A non-circular hole may be inspected as a combination of transition points and accepted in this manner.

HOLE MEASUREMENT

A hole measurement is made by a routine first determining four chord lengths of a hole feature within the optical field of the digitizer camera. These chord lengths are at an angle of 45 degrees to each other. Proprietory routines within the computer analyze the digitized optical results and determine a hole center. Once the hole center is determined, another routine determines the length of four diameters through the derived hole center. The quantitized diameter lengths are then processed to be presented as a four diameter or averaged diameter under program option control.

The operation of the Comp - Gage optical inspection head is described in greater detail in Appendix D.

HOLE MEASUREMENT DIAGRAM



HOLE CENTER
DETERMINATION

HOLE MEASUREMENTS
COMPUTER ROUTINE OPTIONS

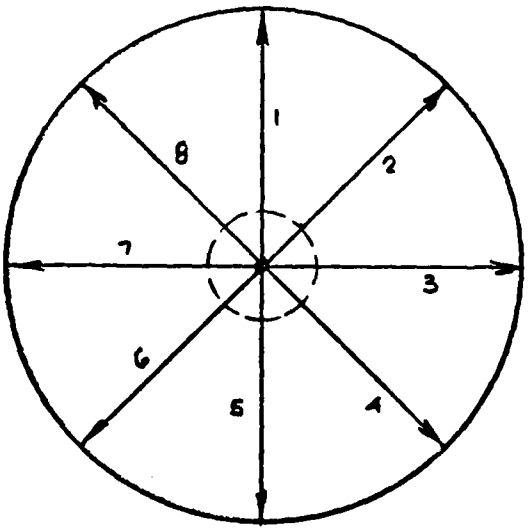
1. D_1, D_2, D_3, D_4 } AVERAGED

DT AVERAGE
HOLE DIAMETER

OHL – FAIL
ULL – ACCEPT
FAIL

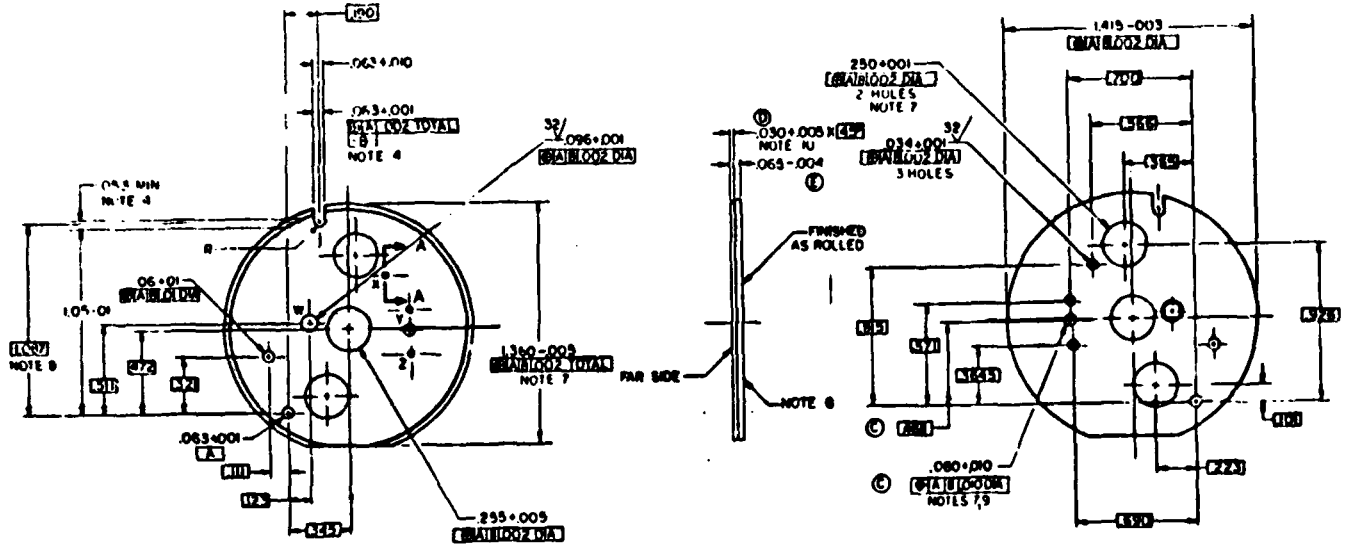
2. D_1 DIA.
D_2
D_3
D_4

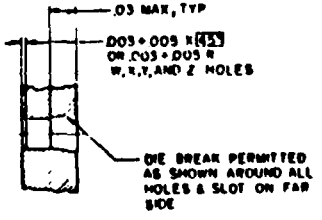
OHL – FAIL
ULL – ACCEPT
FAIL



HOLE MEASUREMENT
WITH DERIVED CENTER

577 LAMINA DRAWINGS V11





SECTION A-A
SCALE 20/1

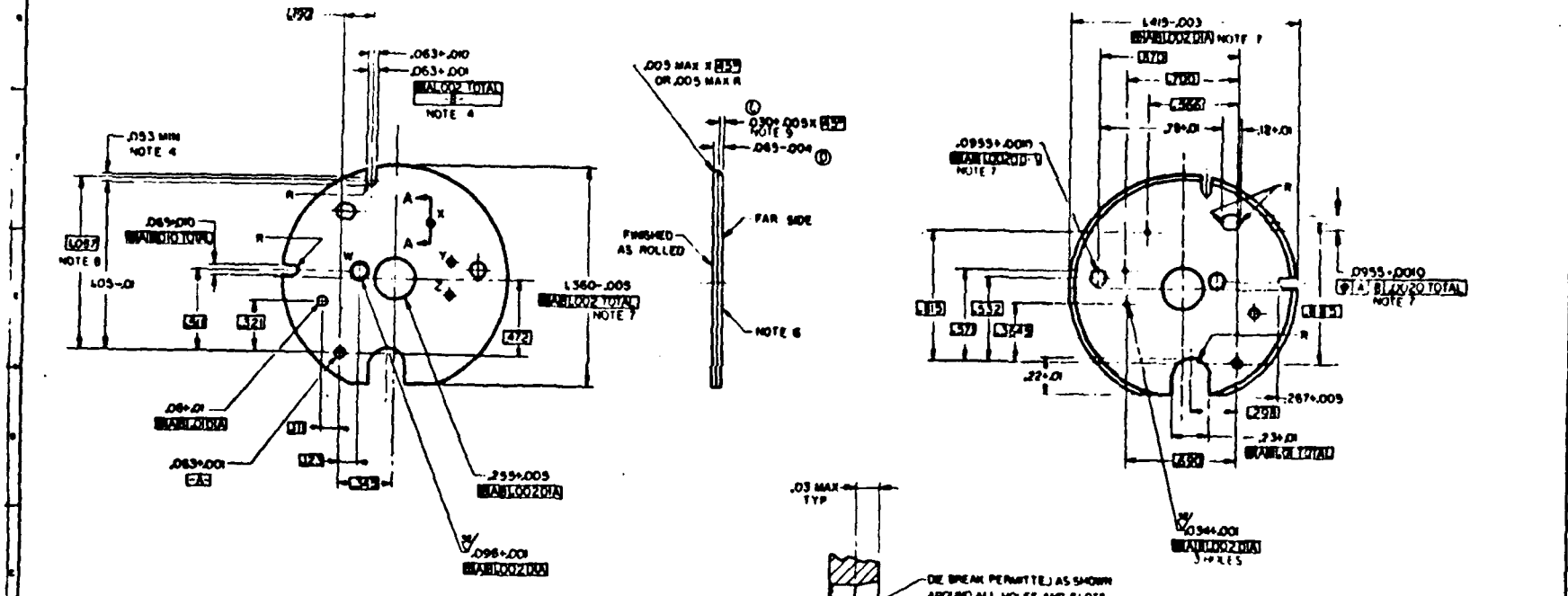
NOTES:-

1-SPEC MIL-A-2550 APPLIES.
2-MATERIAL:-ALUMINUM ALLOY SHEET AND PLATE, ALLOY 2024-T4, T62 OR 6061-T4, ASTM-B209.
3-UNLESS OTHERWISE SPECIFIED, ALL SHARP EDGES TO BE .01 MAX X45° BASIC OR .01 R MAX.
4-.063+.001 DIMENSION APPLIES FOR INDICATED LENGTH.
5-125 FINISH ALL OVER, EXCEPT AS NOTED.
6-PART MAY BE CONCAVE OR CONVEX WITHIN .002.
7-KEY AUTOMATIC ASSEMBLY DIMENSIONS.
8-DIMENSION INDICATED IS FOR INSPECTION PURPOSES.
(C) 9-OPTIONAL HOLE FOR LUBRICATION ACCESS AFTER ASSEMBLY.
(D) 10-CHAMFER INDICATED IS MANDATORY FOR COMPONENTS TO BE ASSEMBLED ON ASSEMBLY MACHINE, DWG NO. 9249670 PER THE REQUIREMENTS OF NOTE 6, DWG NO. 9236526. OTHERWISE CHAMFER INDICATED IS MANDATORY ONLY IN THOSE AREAS INTO WHICH THE SPACER, SSD IS FORMED OR STAKED PER THE REQUIREMENTS OF NOTE 2 ON DRAWING 9236526.

PART NO. 9236527

PLATE, BOTTOM, SSD

SIZE	CODE IDENT NO.	DWG NO.
F	19200	9236527



SECTION A-A
SCALE 20/1

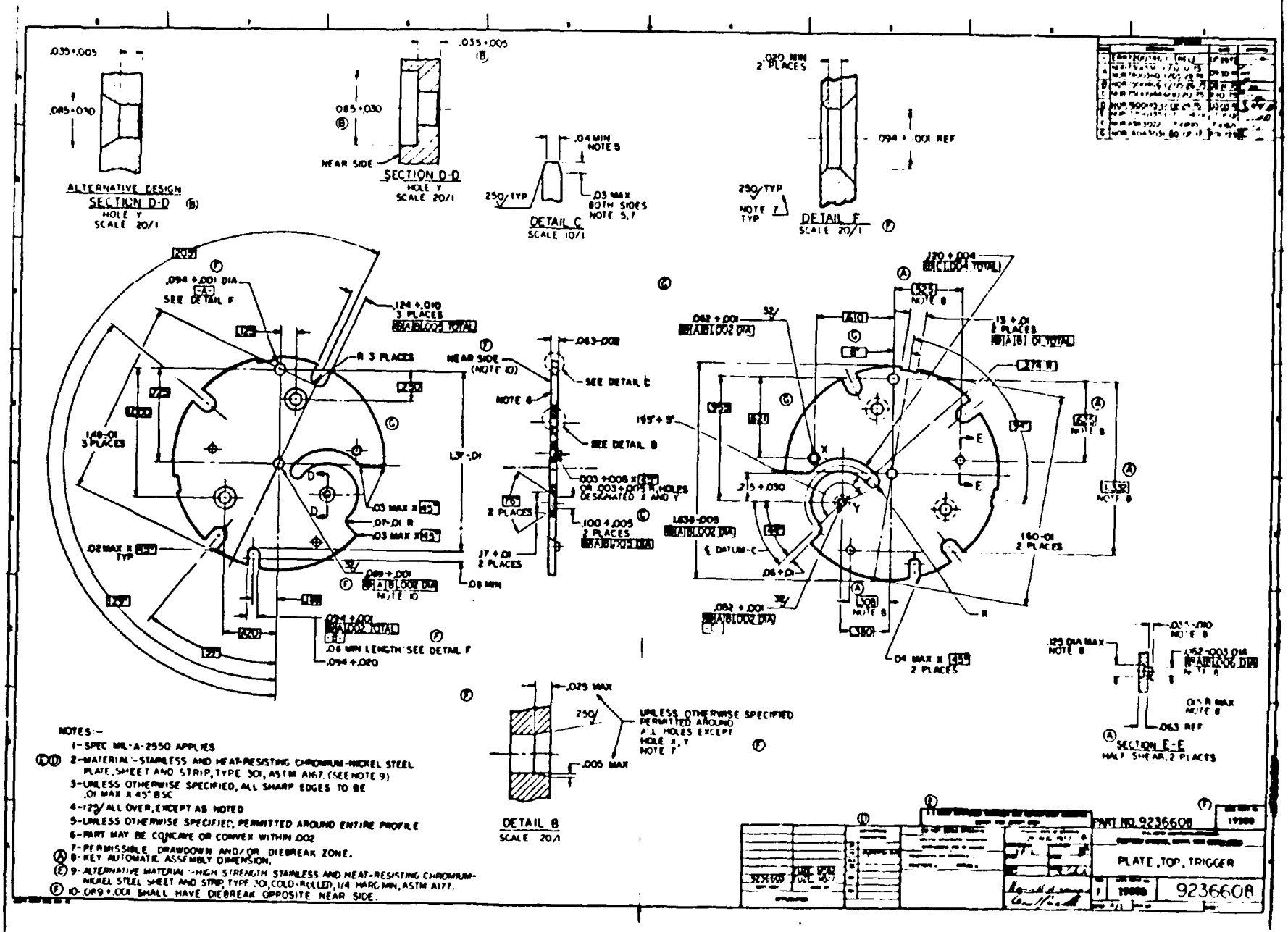
NOTES:-

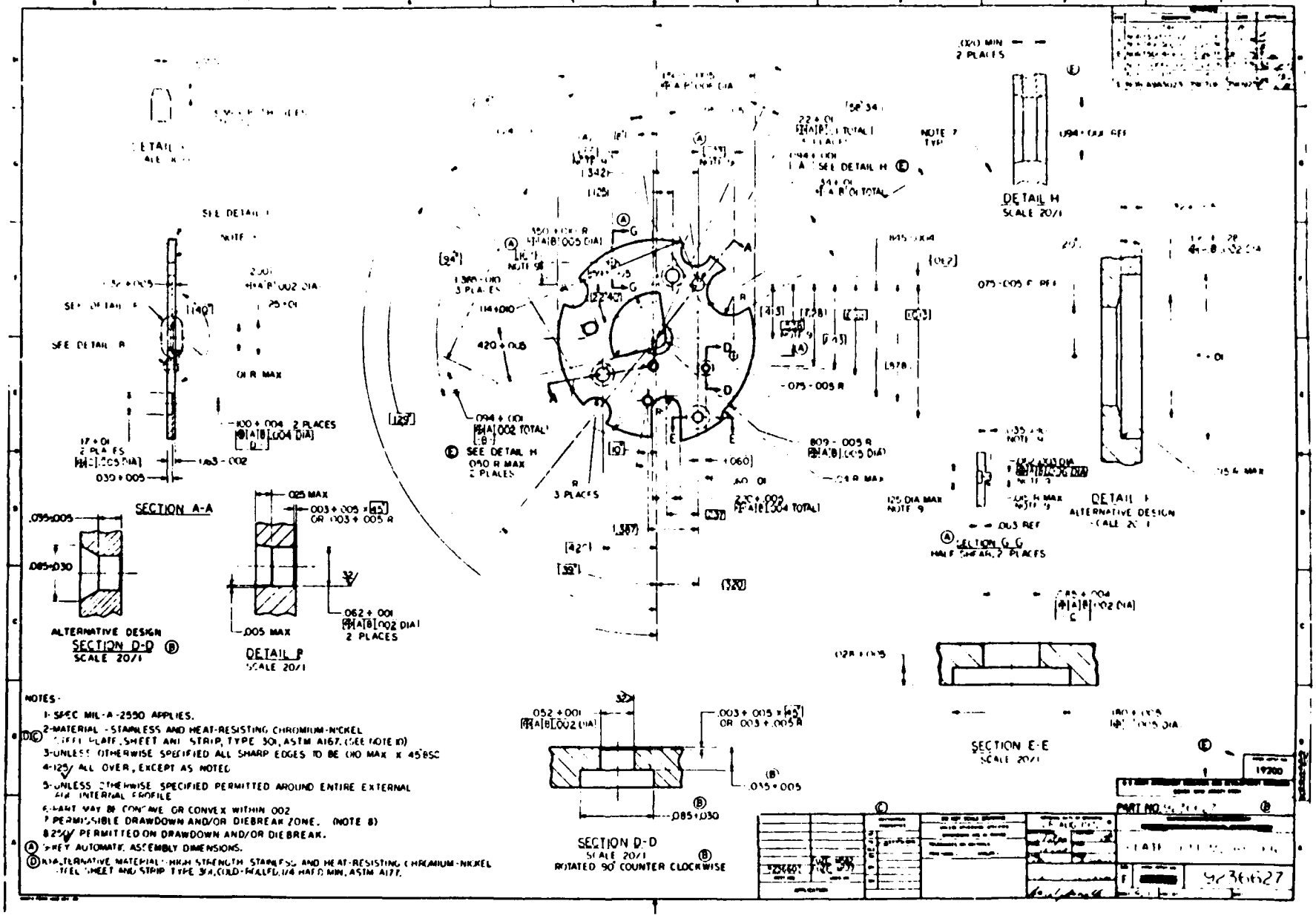
1- SPEC MIL-A-2550 APPLIES.
2- MATERIAL:-ALUMINUM-ALLOY SHEET AND PLATE, ALLOY 2024-T4, T62 OR 6061-T4, ASTM B209.
3- UNLESS OTHERWISE SPECIFIED, ALL SHARP EDGES TO BE .01 MAX X 45° BASIC OR .01 R MAX.
4- .063+.001 DIMENSION APPLIES FOR INDICATED LENGTH.
5- 125 ALL OVER, EXCEPT AS NOTED.
6- PART MAY BE CONCAVE OR CONVEX WITHIN .002.
7- KEY AUTOMATIC ASSEMBLY DIMENSIONS.
8- DIMENSION INDICATED IS FOR INSPECTION PURPOSES.
9- CHAMFER INDICATED IS MANDATORY FOR COMPONENTS TO BE ASSEMBLED ON ASSEMBLY MACHINE, DWG NO 9249920 PER THE REQUIREMENTS OF NOTE 5, DWG NO. 9236552. OTHERWISE, CHAMFER INDICATED IS MANDATORY ONLY IN THOSE AREAS INTO WHICH THE SPACER, SSD IS FORMED OR STAKED PER THE REQUIREMENTS OF NOTE 2 ON DRAWING 9236552.

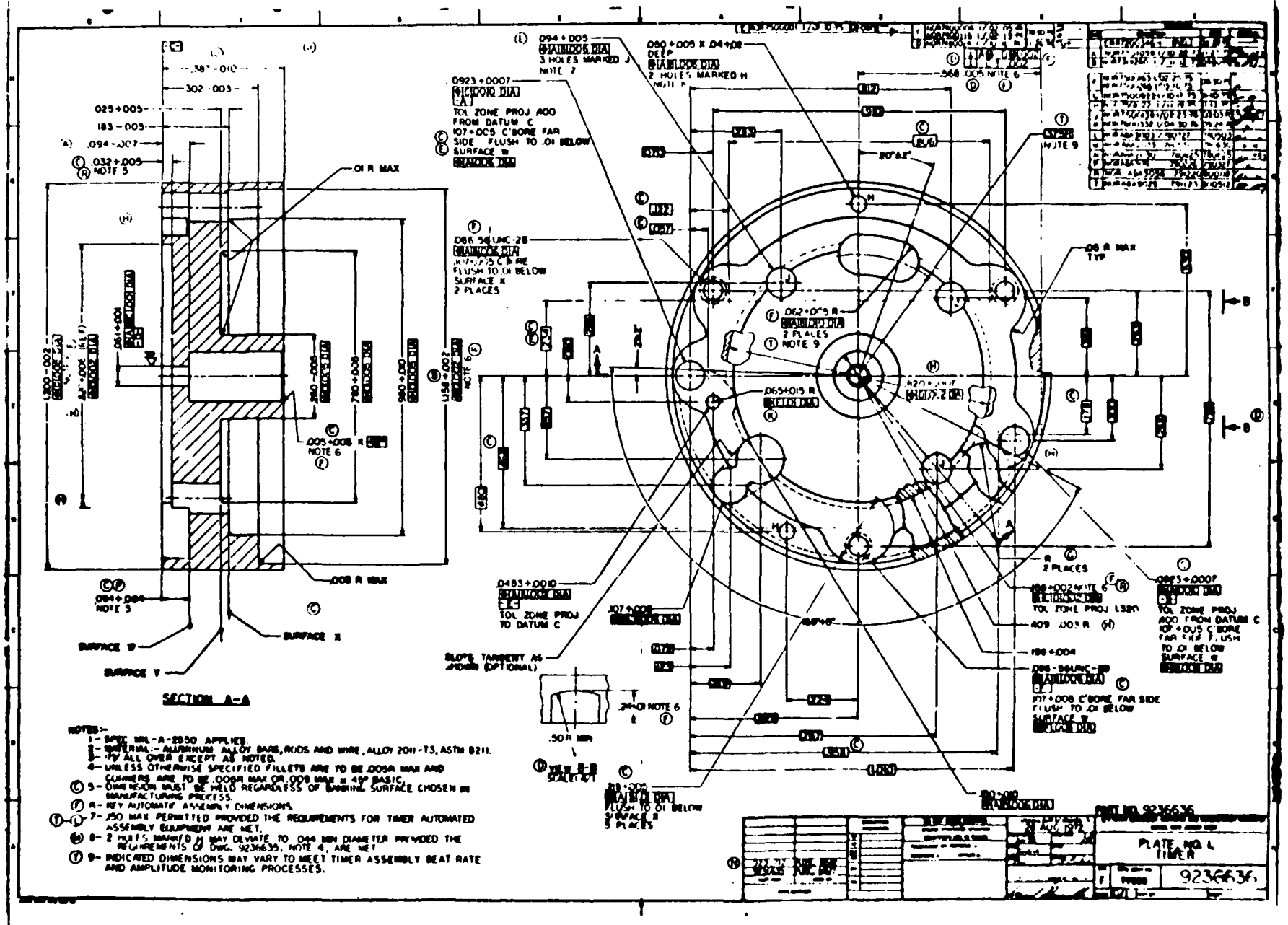
PART NO 9236553

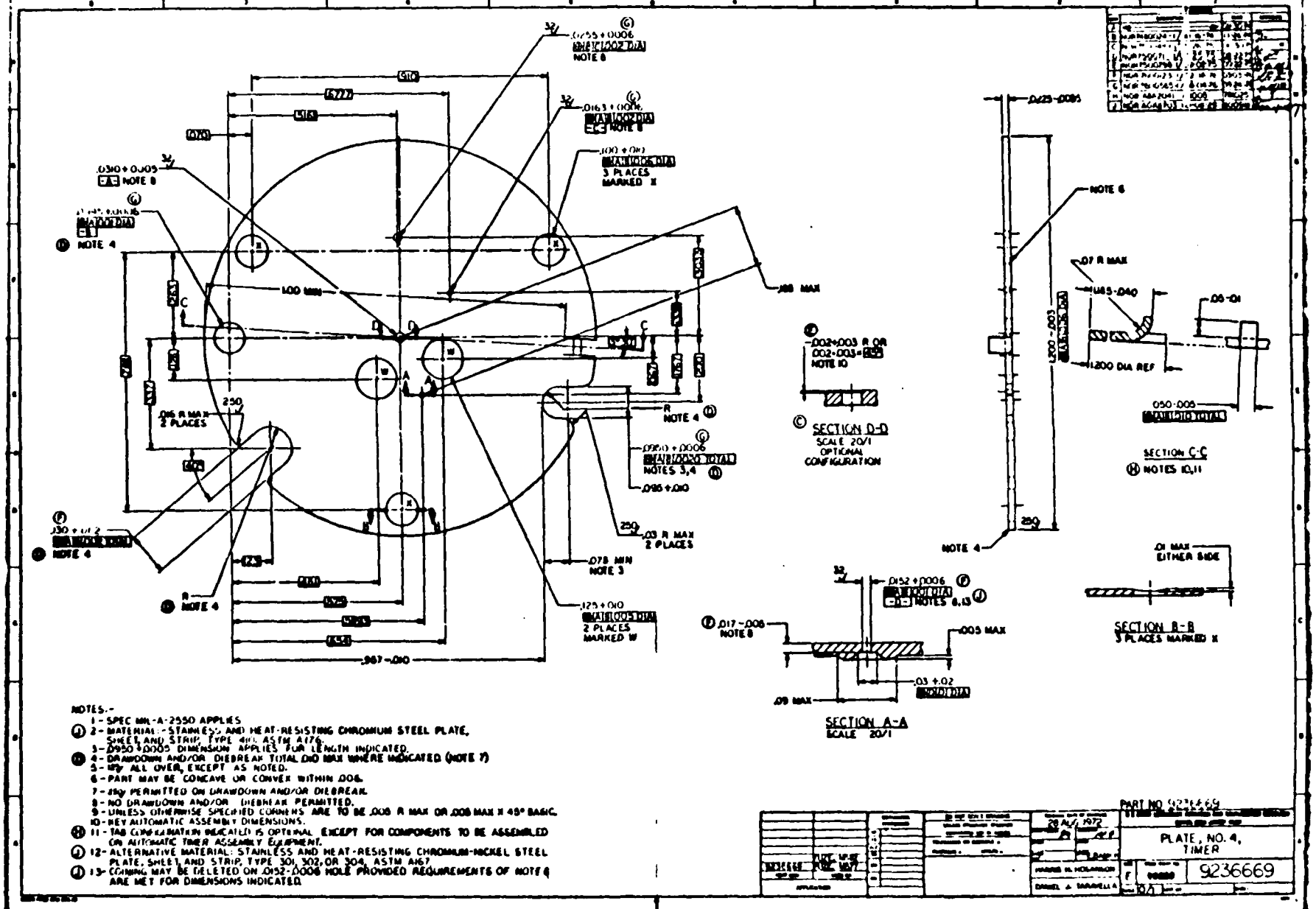
PLATE, TOP, SSD

F | 19280 | 9236553


ALTERNATIVE DESIGN
SECTION D-D (B)
HOLE Y
SCALE 20/1
SECTION D-D
HOLE Y
SCALE 20/1
DETAIL C
SCALE 10/1
DETAIL F
SCALE 20/1
DETAIL B
SCALE 20/1
SECTION E-E
HALF SHEAR, 2 PLACES
NOTES:-
1-SPEC MIL-A-2550 APPLIES
2-MATERIAL:-STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL PLATE, SHEET AND STRIP, TYPE 301, ASTM A167. (SEE NOTE 9)
3-UNLESS OTHERWISE SPECIFIED, ALL SHARP EDGES TO BE .01 MAX X 45° BSC
4-125 ALL OVER, EXCEPT AS NOTED
5-UNLESS OTHERWISE SPECIFIED, PERMITTED AROUND ENTIRE PROFILE
6-PART MAY BE CONCAVE OR CONVEX WITHIN .002
7-PERMISSIBLE DRAWDOWN AND/OR DIEBREAK ZONE.
8-KEY AUTOMATIC ASSEMBLY DIMENSION.
9-ALTERNATIVE MATERIAL:-HIGH STRENGTH STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL SHEET AND STRIP TYPE 301, COLD-ROLLED, 1/4 HARD MIN, ASTM A177.
10-.089 +.001 SHALL HAVE DIEBREAK OPPOSITE NEAR SIDE.
PART NO. 9236608
PLATE, TOP, TRIGGER
9236608


DETAIL H
SCALE 20/1
SECTION A-A
SECTION D-D
SCALE 20/1
DETAIL P
SCALE 20/1
SECTION G-G
DETAIL P
ALTERNATIVE DESIGN
SECTION E-E
SCALE 20/1
SECTION D-D
SCALE 20/1
ROTATED 90° COUNTER CLOCKWISE
NOTES:
1. SPEC MIL-A-2550 APPLIES.
2. MATERIAL - STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL PLATE, SHEET AND STRIP, TYPE 301, ASTM A167. (SEE NOTE D)
3. UNLESS OTHERWISE SPECIFIED ALL SHARP EDGES TO BE .010 MAX X 45° BSC
4. 125 ALL OVER, EXCEPT AS NOTED
5. UNLESS OTHERWISE SPECIFIED PERMITTED AROUND ENTIRE EXTERNAL AND INTERNAL PROFILE
6. PART MAY BE CONCAVE OR CONVEX WITHIN .002
7. PERMISSIBLE DRAWDOWN AND/OR DIEBREAK ZONE. (NOTE 8)
8. 25% PERMITTED ON DRAWDOWN AND/OR DIEBREAK.
A. GREY AUTOMATIC ASSEMBLY DIMENSIONS.
D. ALTERNATIVE MATERIAL - HIGH STRENGTH STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL SHEET AND STRIP TYPE 301, COLD-REALED, 1/4 HARD MIN, ASTM A177.
PART NO.
19200
9236627


SECTION A-A
SURFACE W
SURFACE X
SURFACE Y
NOTES:-
1- SPEC MIL-A-2550 APPLIES.
2- MATERIAL:- ALUMINUM ALLOY BARS, RODS AND WIRE, ALLOY 2011-T3, ASTM B211.
3- ±.010 ALL OVER EXCEPT AS NOTED.
4- UNLESS OTHERWISE SPECIFIED FILLETS ARE TO BE .005R MAX AND CORNERS ARE TO BE .008R MAX OR .009 MAX = 45° BASIC.
5- DIMENSION MUST BE HELD REGARDLESS OF DATUM SURFACE CHOSEN IN MANUFACTURING PROCESS.
6- KEY AUTOMATIC ASSEMBLY DIMENSIONS.
7- .250 MAX PERMITTED PROVIDED THE REQUIREMENTS FOR TIMER AUTOMATED ASSEMBLY EQUIPMENT ARE MET.
8- 2 HOLES MARKED M MAY DEVIATE TO .044 MIN DIAMETER PROVIDED THE REQUIREMENTS OF DWG. 9236635, NOTE 4, ARE MET
9- INDICATED DIMENSIONS MAY VARY TO MEET TIMER ASSEMBLY BEAT RATE AND AMPLITUDE MONITORING PROCESSES.
PLATE, NO. 1 TIMER
9236636



NOTES.-

1 - SPEC MIL-A-2550 APPLIES
(J) 2 - MATERIAL: STAINLESS AND HEAT-RESISTING CHROMIUM STEEL PLATE, SHEET AND STRIP, TYPE 410, ASTM A176.
3 - .0950 +.0005 DIMENSION APPLIES FOR LENGTH INDICATED.
(H) 4 - DRAWDOWN AND/OR DIEBREAK TOTAL .010 MAX WHERE INDICATED (NOTE 7)
5 - .005 ALL OVER, EXCEPT AS NOTED.
6 - PART MAY BE CONCAVE OR CONVEX WITHIN .006.
7 - .005 PERMITTED ON DRAWDOWN AND/OR DIEBREAK.
8 - NO DRAWDOWN AND/OR DIEBREAK PERMITTED.
9 - UNLESS OTHERWISE SPECIFIED CORNERS ARE TO BE .008 R MAX OR .008 MAX X 45° BASIC.
10 - KEY AUTOMATIC ASSEMBLY DIMENSIONS.
(H) 11 - TAB CONFIGURATION INDICATED IS OPTIONAL EXCEPT FOR COMPONENTS TO BE ASSEMBLED ON AUTOMATIC TIMER ASSEMBLY EQUIPMENT.
(J) 12 - ALTERNATIVE MATERIAL: STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL PLATE, SHEET, AND STRIP, TYPE 301, 302, OR 304, ASTM A167.
(J) 13 - COINING MAY BE DELETED ON .0152-.0006 HOLE PROVIDED REQUIREMENTS OF NOTE 6 ARE MET FOR DIMENSIONS INDICATED.

PART NO. 9236669

28 AUG 1972

PLATE, NO. 4, TIMER

9236669


FILMED
7-8